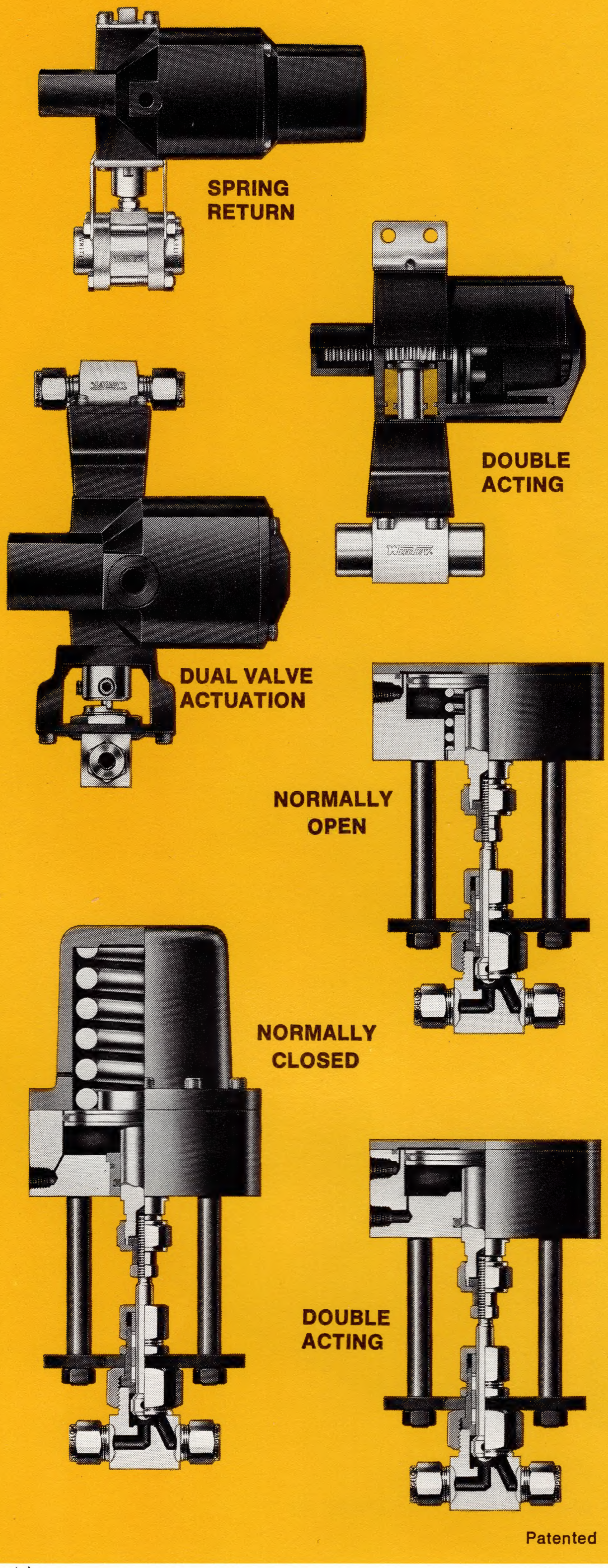
MECHANICAL ENGINEERING

JANUARY 1981

SPECIFY

WHITEY AIR OPERATED VALVES

for safe, reliable service in hazardous, inaccessible or remote areas



Air Operated Ball Valves

- Double Acting and Spring Return air operators have either 90° or 180° actuation.
- Spring Return models provide fail safe service for emergency shut down and other critical functions.
- Compact, lightweight designs minimize load on tubing or piping.
- Operate from standard shop air or any other clean, non-corrosive fluid.

WHITEY Top-Loaded and Swing-Out Ball Valves with air operators are available in brass and 316 stainless steel, with tube or pipe ends, from distributor stocks.

SWAGELOK Tube Fitting end connections are available on all models.

Air Operated Severe Service Union Bonnet Valves

- Normally Open, Normally Closed and Double Acting air operators require low operating pressures, 100 psi or less, to control valve pressures to the full 6000 psi rating.
- Normally Open and Normally Closed models are fail safe.
- Compact design reduces space, weight and air consumption to a minimum.
- Stem travel and packing are easily adjustable.

WHITEY Severe Service Valves with air operators are available from local distributor stocks in 316 stainless steel, with **SWAGELOK**, pipe or weld end connections.

WHITEY®

WHITEY CO.
318 Bishop Road
Highland Heights, Ohio 44143

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If you're looking for extensive advanced software along with rapid job turnaround, look into Babcock & Wilcox Computer Services. The whole story is in our brochure.

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MECHANICAL ENGINEERING

VOLUME 103 **NUMBER 1** **JANUARY 1981**

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MECHANICAL ENGINEERING (ISSN 0025-6501) is edited and published monthly at the offices of the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th St., New York, N.Y. 10017. ASME TWX number 710-581-5267. Second-class postage paid at New York, N.Y., and at additional mailing offices.

PRICES: to members annually $5.00 for initial membership subscription, $8.00 for additional subscriptions, single copy 80 cents; subscription price to nonmembers available upon request. Add $5.00 for postage to countries outside the U.S. and Canada.

INDEXED by the Engineering Index, Inc., and the Applied Science and Technology Index.

MOVING?
Please Use Form on Last Page

Opinion and Comment

Technical Developments

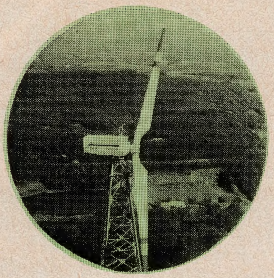
News of the Profession

Engineering Education

Upcoming Meetings

News of Members

THE COVER



Windmills were used as a power source many years before the industrial revolution. But since the development of fossil-fueled heat engines, the application of wind power has been infinitesimal. Now with the growing energy crisis upon us, windmills must again be given serious consideration as an economical energy source in certain industrial applications. Our cover this month shows a 2000-kW windmill generating plant at Boone, N.C. It calls our readers' attention to an article describing an economic study that evaluates a windmill as a power source for industrial forklift trucks. Turn to page 30. Photograph courtesy of NASA-Lewis Research Center.

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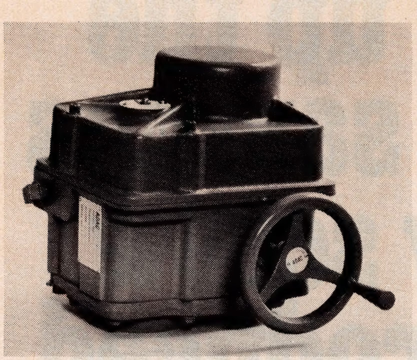


Quarter-Turn Actuator

ADAC—A new quarter-turn valve actuator incorporates a patented, self-locking gear train system that provides maximum mechanical efficiency (60 percent minimum) and eliminates the need for declutching. Because of the greater efficiency of the actuator's gear train system, motor horsepower and size requirements are reduced, resulting in lower installation, operation and initial costs. This design innovation also permits more precise process flow control by speeding response to opening or closing commands; no dwell time results when the rotation of the actuator is reversed.

Circle 150 on Reader Service Card

Fiber Optics

American Optical Corp.—New Special Fiber Optics catalog lists fiberscopes, image guides, relay lenses and light guides that are, or can be, manufactured by AO to meet specialized customer needs. Some of the products described include malleable fiberscopes for repetitive inspections and/or hard to reach areas; small diameter fiberscopes for internal viewing of equipment with limited openings; heavy duty stainless steel "stayput" flexible shafts and high temperature light and image guides for tough industrial applications.

Circle 151 on Reader Service Card

Pump Guard

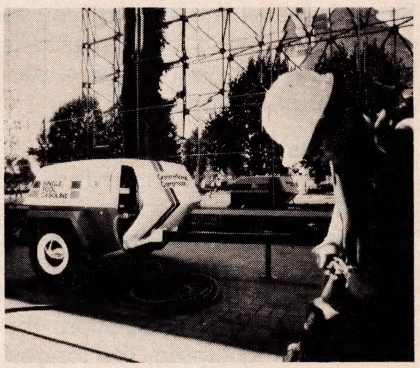
Control Electronics Corp.—The Sentry 1® pump guard uses ultrasonics to protect virtually any kind of pump from overheat damage that can result when flow is either throttled or completely shut off. When flow to the pump approaches a critically low level, the output of the Sentry 1 can be used to signal an audible/visual alarm, or even break the circuit to shut off the pump. It installs easily on pipe 1 in. or larger.

Circle 152 on Reader Service Card

Controller With Separate Programmer

Entertron Industries Inc.—Bulletin introduces its microprocessor-based controller, Model SK-1506, and separate programmer, Model 8K. It is described as a specially designed system to replace conventional relay and timer systems incorporating from five to 50 relays. Features covered in the bulletin include: by replacing individually wired relay systems, the new programmable controller saves space, reduces costs, and improves reliability; all capabilities needed to control most sequential operations, without the high cost of more complex systems are provided.

Circle 153 on Reader Service Card



Portable Air Compressor

GrimmerSchmidt Corp.—A new economy model portable compressor, the Single Tool Gasoline, is powered by a Ford V-302 and uses the GrimmerSchmidt Mono-block system—one bank of cylinders supplies the power and the other bank supplies the air. Features include patented water-cooled compressor valves, safety shutdowns, double-walled fiberglass enclosure, two-stage air cleaner, and torsion spring suspension.

Circle 154 on Reader Service Card

Sealers, Lubricants and Gaskets

Crane Packing Co.—Bulletin PLS-5016 describes its complete line of sealers, lubricants and gaskets. The 18-page brochure fully explains and illustrates each product. Included are typical applications, services, temperature and pressure ranges with available sizes for all products. The entire line of thread sealers, thread protectors, penetrants, lubricants and gasket materials has been updated.

Circle 155 on Reader Service Card

Ultrasonic Gage

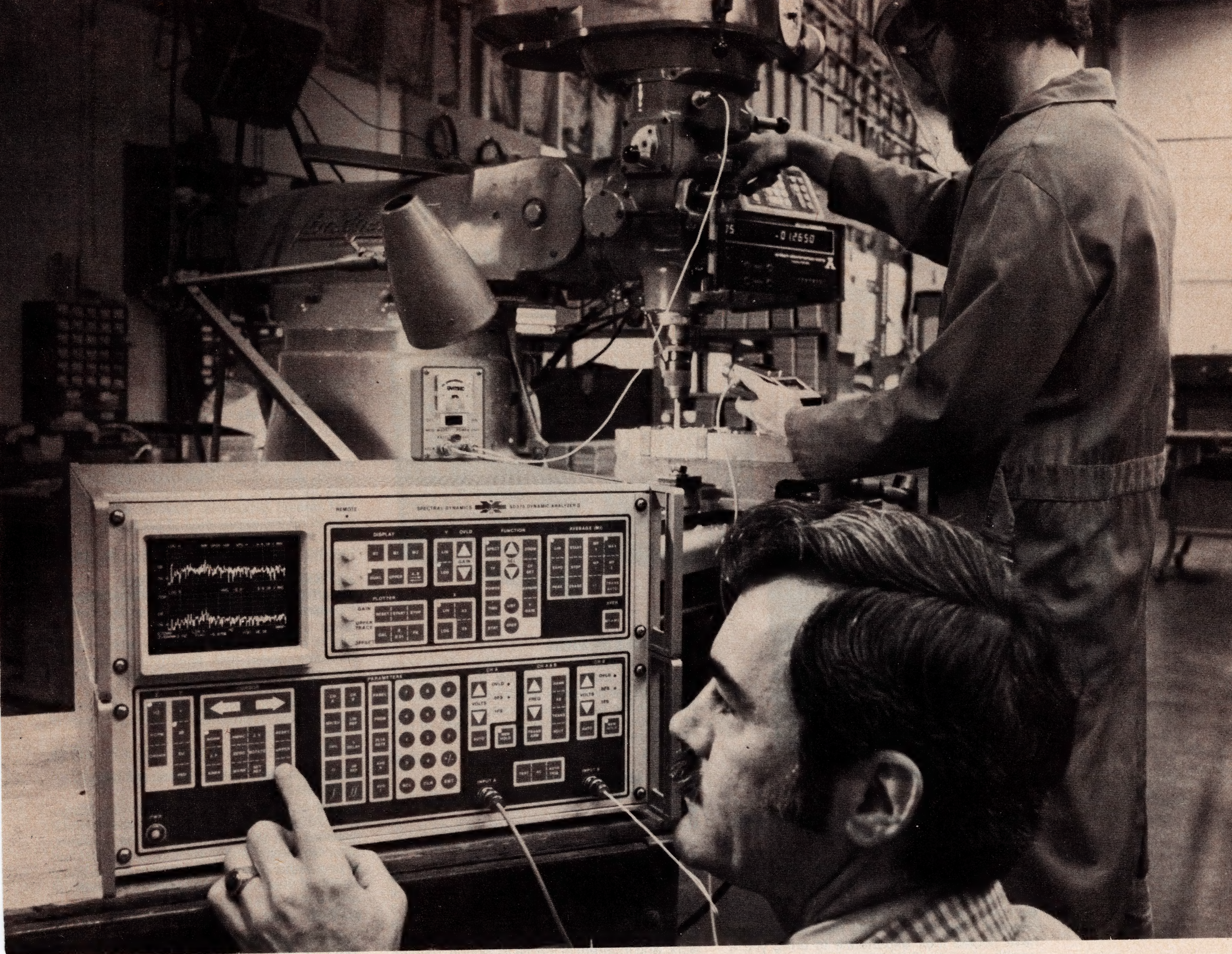
Elcometer, Inc.—A battery-operated digital-readout ultrasonic wall thickness gage, called the Elcometer 200, is designed for convenient hand-held use and pre-calibrated for the direct measurement of wall thicknesses in steel ranging from 1.5 to 99.9 mm. It requires minimal operator skills and eliminates the need for adjustments of any kind. The unit is ideal for routine thickness measurements of raw steel materials in various steps of the manufacturing process: from forging or casting, to fabrication and machining, and on through to the finished product. The instrument is also extremely useful for on-site thickness monitoring to determine the effects of corrosion and erosion on steelwork, pipelines, storage tanks, and other plant equipment made from steel.

Circle 156 on Reader Service Card

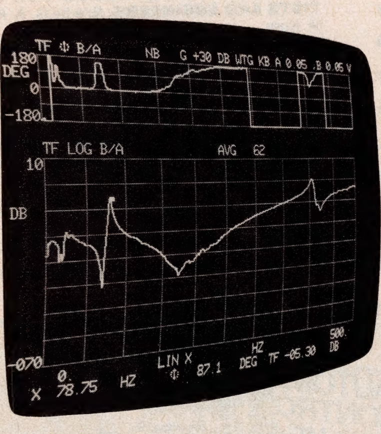
Photoelectric Systems For Solving Motion Control

Warner Electric Brake & Clutch Co.—The new "16 Ways" brochure details a wide variety of problem-solving applications with photoelectrics for packaging, material handling, web processing and plant-industrial equipment. It covers the four basic Warner Visolux LED and incadescent photoelectric systems: diffuse reflective, specular reflective, retro-reflective and thru-beam for an almost limitless variety of motion control applications. In-plant applications cover automatic door and operator safety control, security, and truck height sensing.

Circle 157 on Reader Service Card



Introducing the SD375. The two-channel analyzer that's easy to operate . . . and easy to buy.



The SD375 isn't the first two-channel signal processor on the market. Just the smartest. And the most versatile and easiest to set up and operate. And, above all, more features and capabilities per dollar — $19,600 base U.S. price — than any other two-channel analyzer on the market.

It tells you everything you want to know about signals and their cross properties . . . *instantly.* Full annotation is the key. The SD375 shows clearly every parameter and scaling factor of the test . . . where the test is at every moment . . . and (after the test) instantly readable results. No guesswork, no mysterious codes, no tricky conversions to be made.

Results are what you need, and fully processed results are what you get on a crystal-clear raster scan display. Readouts are available either in absolute values or calibrated and displayed directly in full engineering units — e.g. mils, g's, mechanical impedance, dynamic stiffness (or even furlongs per fortnight, if that's what you want).

The SD375's display conforms to the way you're used to seeing graphed information; you don't have to learn new ways of reading and interpreting a CRT to get the test results you need . . . *immediately.*

Plug-in options such as digital zoom and IEEE 488/RS-232 digital I/O add to the ease of using the new SD375. The digital I/O option permits *direct* connection to a variety of both TEK and H-P digital plotters . . . today's most widely owned, established display peripherals. The same digital I/O plug-in also provides unusually broad capabilities for remote control and sensing and computer processing of analytical data.

If you have two signals and have to know . . . *fast* . . . what's in them and how they inter-relate, find out about the new SD375. Call Roger Koch at (714) 268-7129. Or write to us.

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Spectral Dynamics
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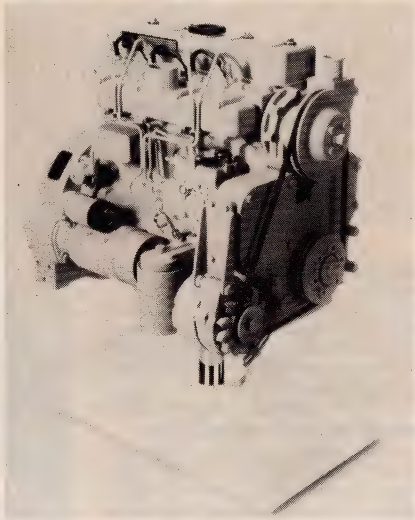
keep informed



Industrial Diesel Engines

Onan Corp.—Its new L Series diesel engines are advanced, water-cooled engines designed for industrial use. They will be available in two, three, four and six cylinders, with horsepower ratings of from 15 to 115. The new L Series engines will be high speed, (3600 rpm) and are sized for a wide range of applications including mobile refrigeration, pumps, compaction equipment, intermediate tractors, turf care equipment, skid steer loaders, trenchers, compressors, forklifts, welders and marine use, as well as generator sets.

Circle 158 on Reader Service Card

Pump Vibration Problems

Nicolet Scientific Corp.—"Solving Pump Problems . . . Using Vibration Spectrum Analysis" is an 8-page application note (AN13). It describes the Model 446B-1311 Mini-Ubiquitous FFT Computing Spectrum Analyzer which incorporates a built-in tape cassette for storing and recalling signatures from past tests for comparison with current signatures to measure the increase of vibration at each frequency.

Circle 159 on Reader Service Card

Pipe Design Calculator

Ciba-Geigy Pipe Systems—A new pocket-sized slide-rule type calculator, helpful in simplifying several computations involving pipe systems design, is available free. The calculator is designed to assist specifiers considering using its fiberglass pipe. Metric conversions factors for flow rates, velocities, lengths, pressures and friction loss, as well as a table which equilibrates friction loss through fittings with their equivalent pipe lengths, are also included on the calculator.

Circle 160 on Reader Service Card

Audio Transducers

Gulton Industries, Piezo Products Div.—A series of packaged piezoceramic CATT® audio transducers, frequently referred to as speakers, are for applications requiring various alarms, signals, or verification. The audio transducer consists of a piezoceramic CATT® element housed in a plastic resonator casing, so that no additional holder is required.

Circle 161 on Reader Service Card

Air-Oil Tanks

Lin-Act Manufacturing—Series TA air-oil tanks for applications up to 250 psi have been added to its complete line of cylinder products. The tanks are designed for use in air-oil circuits, a low-cost method of obtaining hydraulic cylinder control in air systems. Air-oil tanks are also used in a wide variety of intensifier circuits. The tanks feature a high strength fiberglass tube. No sight gauge is necessary as oil level is visible through the translucent fiberglass. The tanks have internal baffles to reduce foaming for more efficient hydraulic control of the cylinder.

Circle 162 on Reader Service Card

Experimental Stress Analysis

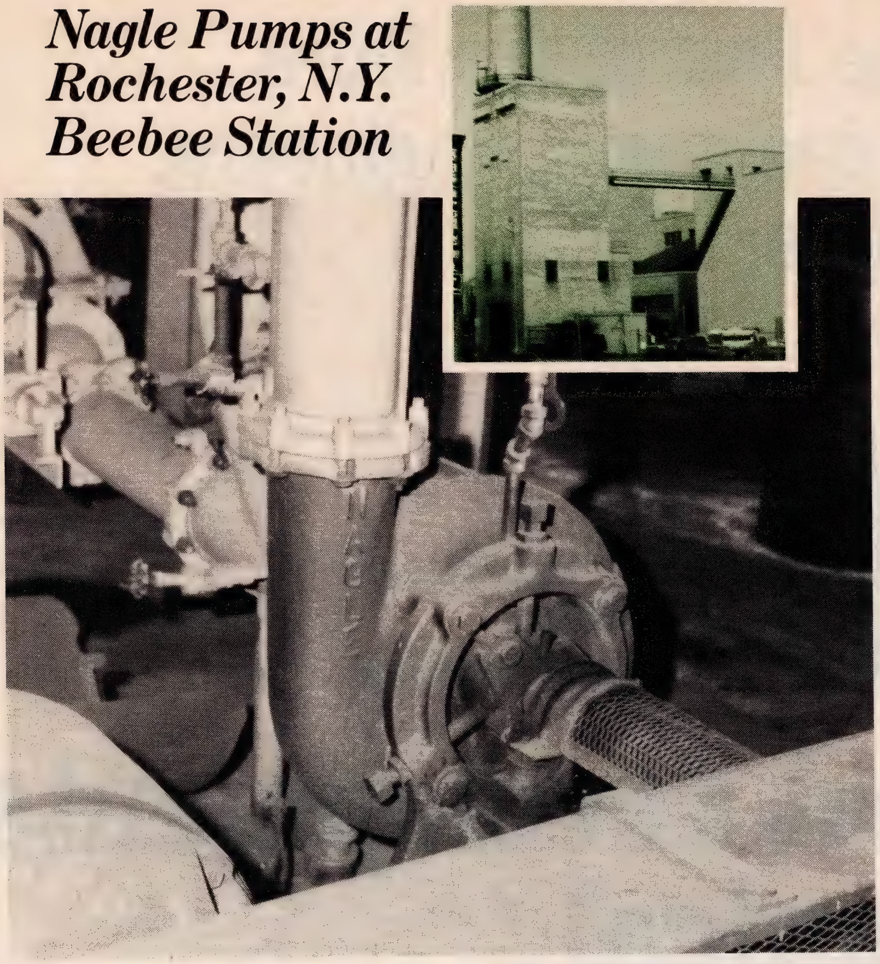
Vishay Intertechnology, Inc.—A 20-page brochure provides a closer look at the products of each division of its Measurements Group, and the way in which they are used to achieve design reliability. The techniques of experimental stress analysis are explained and pictorial examples are offered of how and where these techniques are currently being employed in laboratory and field testing.

Circle 163 on Reader Service Card

Horsepower Limiter Control

The Oilgear Co.—Performance curves, dimensions and principle of operation are included in Hydura Products new bulletin on horsepower limiting controls. The controls automatically limit hydraulic pump output within a range dictated by your application of power source. The control is available for all of its hydrostatic, dual, atmospheric inlet or high water base fluid pumps. Features include: input energy savings while maximizing power output; cost savings through use of smaller prime movers; inclusion of a pressure compensator override; stepless response to pressure variations; and a wide selection of horsepower control ranges.

Circle 164 on Reader Service Card



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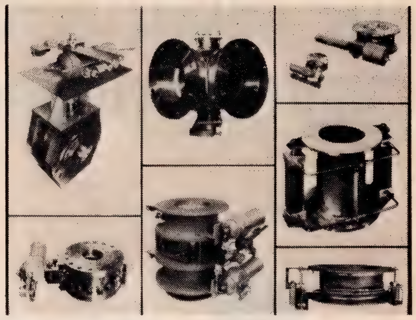

Spherical Valves

General Machine Co. of New Jersey, Inc.—Detailed specifications for its spherical valves for controlling the flow of solids or slurries are given in a new brochure. Intended for the guidance of those concerned with the controlled transfer of free-flowing solids, the six-page brochure gives detailed dimensions and specifications for the four types of "Dust-Tite" valves in the Gemco Line. The valves handle solids, slurries and toxic chemicals on bins and hoppers; drum fillers, gravity feed lines, pneumatic conveyors; portable hoppers; solids formulators, tumble blenders and vacuum dryers.

Circle 165 on Reader Service Card

Hydraulic Turbines

Allis-Chalmers Corp.—Its axial flow hydraulic turbine is the subject of a 22-page brochure which is divided into eight sections. Background information is included on axial flow hydropower. Among the numerous illustrations are turbine cross-sections, photographs of the laboratory, engineering, and manufacturing facilities; and reproductions of typical graphs, charts and computer displays used for analysis and design.

Circle 166 on Reader Service Card

Stepper Motors and Controls

Motion Products—Fourteen-page bulletin illustrates and describes the company's Electro-Hydraulic Stepper Motors and Controls. If a small electrical stepper could be used to control the power available from a hydraulic motor, the advantages of direct digital control could be spread over a very wide horsepower range. An electro-hydraulic stepper motor is a device which successfully exploits this concept. The electro-hydraulic stepper motor has three components: Electrical stepper motor, servo-valve, and hydraulic motor. These motors would replace many complex servo-systems and their components such as tachometers, synchros, resolvers, and position transducers.

Circle 167 on Reader Service Card

(Continued on page 108)

Houston Lighting and Power is the nation's sixth largest and fastest growing utility company. Continuing energy demands mean long term career opportunities and an excellent benefits package that includes RELOCATION expenses for degreed energy professionals with at least two years experience in one or more of the following areas.

CHEMICAL ENGINEERS

Experience in power plant chemical systems such as boiler, water quality and treatment, boiler chemical cleaning, waste water treatment systems and flue gas desulfurization systems.

MECHANICAL/NUCLEAR ENGINEERS

Knowledge of fossil and nuclear power plants related to turbines, rotating equipment, boilers, heat transfer equipment and air quality systems.

ELECTRICAL ENGINEERS

Knowledge of industrial or power plant electrical auxiliary systems and equipment and experience in conducting economic and schedular evaluations.

CIVIL ENGINEERS

Requires geotechnical, civil/structural or general civil engineering experience. Home office and site positions available at nuclear and fossil power plants.

INSTRUMENTATION AND CONTROL ENGINEERS

Familiar with control system application which encompasses selection and preparation of installation procedures. Economic evaluation and cost justification of control system. Design review of control systems to endure maintainability, operability and reliability.

PROJECT ADMINISTRATORS/ CONTRACT ANALYSTS

Qualifications include a Bachelor's degree and, preferably, experience with an E&C or utility firm in contract administration. Responsibilities will encompass the development administration of HL&P engineering and construction contracts for its major plant improvements, including compliance monitoring and resolution of discrepancies. Will also provide project management support.

PLANNING/SCHEDULING

Proficiency in the planning and scheduling of the engineering, procurement and construction of major projects. Detailed knowledge and extensive experience in the use of CPM and the analysis of plans and schedules associated with the management of major projects will be required.

COST ENGINEERING

Familiarity with work breakdown structures, work packaging, quantity surveying, cost coding, trending, forecasting, productivity evaluation and progress assessment.

ESTIMATING

Requires cost estimation experience associated with engineering, materials and large power plant construction.

NUCLEAR QUALITY ASSURANCE AUDITORS

Engineering degree preferred, or equivalent work experience. Experience should include a working knowledge of US NRC Nuclear Quality Assurance requirements as defined in 10-CFR-50 Appendix B, regulatory guides, and nuclear industry codes and standards such as ASME Section 3 and ANSI N-45.2

Applicants shall have a background in QA System/Program Audits of design, manufacturing and construction.

Qualifications shall include certification as a lead Auditor in accordance with ANSI NA45.2.23.

Interested candidates should forward resume and salary requirements to:

B.L. Ghio
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Houston Lighting & Power
P.O. Box 1700
Houston, Texas 77001
713/228-5035

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THE POWERFUL CAREER CHOICE

HOUSTON LIGHTING SERVICE FIRST & POWER COMPANY

Houston Lighting & Power

Attention: Engineers Age 40 and Up

Put yourself on easy street by spending pre-retirement years with Aramco in Saudi Arabia

Retirement incomes that sounded princely a few years back are beginning to look paltry in today's economy. And they may be hopelessly inadequate in tomorrow's.

What can you do about it? Come to work for Aramco in Saudi Arabia.

Just compare these Aramco benefits with what you're getting now.

Collect more extras you can put right in the bank

First, you get a tax-protected bonus of up to $5,000 as soon as you join us.

You can join an automatic payroll savings plan in which Aramco matches up to 6 percent of your salary (the match begins at 50 percent and escalates up to 100 percent after ten years of service).

And you participate in Aramco's retirement income plan.

Earn a whopping tax-protected pay premium

We start you off with a base salary that compares with any in the oil industry.

We also give you a cost-of-living differential in Saudi Arabia so that the higher costs of things like food come out of our pocket, not yours.

The best part is our premium for overseas employment. This is *fully* sheltered from all taxes.

We pay you a 40 percent premium on the first $30,000 of base pay—plus a 20 percent premium on the next $20,000. Maximum is $16,000 per year.

Tuition and board anywhere in the world for high schoolers

High school students get their educations in Europe, the United States, anywhere. We pay 80 percent of all tuition and board (up to $4900 annually) for three years of high school.

We also pay air fare for high schoolers visiting parents in Saudi Arabia—three trips per year. (The same goes for air fares for college students but they get fewer trips.)

Youngsters from kindergarten through the ninth grade attend our American-style schools in Saudi Arabia.

Free trip home every year—long vacations

You get 40 days of paid vacation every year—plus an average of 12 holidays every year—plus weekends.

You get a travel allowance every year, too. This is equal to the economy round-trip air fare between Saudi Arabia and the U.S. or Canadian city where you were hired. Good for you *and* your family. Every year.

Where you go is your business. Is it any wonder that so many Aramco people get to see Europe, the Orient, the *world* on their annual leaves?

Free life insurance and health care

You're automatically covered with a life insurance policy the day you join Aramco. No cost to you.

You can also buy extra insurance up to thirty times your monthly salary for about 34¢ a month for every thousand dollars.

Will your retirement home be near some mountain greenery, or farther south within the Sun Belt, or on the shores of the Pacific? Aramco's big bundle of benefits will help you secure it sooner than you think. See below.

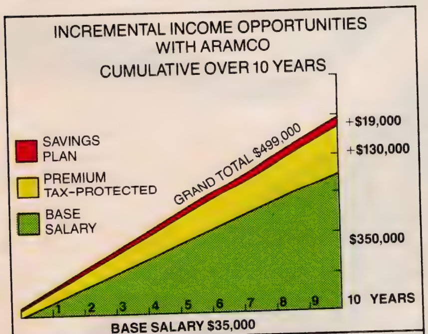
All your medical needs are free while you are in Saudi Arabia — even your prescriptions.

Unlike medical care, dental care is not free for Aramco employees. However, the costs are comparable to what you'd expect to pay back home.

A chance to save huge sums of retirement money

We can only give you a bare idea of how the money can multiply over a 10-year span. For the sake of illustration, let's add up the fortunes of an engineer working for Aramco in Saudi Arabia making $35,000 U. S. in base pay, with no raises for the 10 years (not likely!). Remember this is just a hypothesis.

Right off, you see that our imaginary engineer in Saudi Arabia can gross



This is not an offer or an indication of wage scales. It is merely a hypothetical example of how your gross income can accumulate dramatically when you work for Aramco in Saudi Arabia. Employees are not fully vested in the savings plan until 60 months of continuous service. All projections subject to change.

around $149,000 more. The amount saved out of that grand total is strictly up to the individual.

But look at that $130,000 premium. Whatever the dollars work out to in your case, please remember that this is the bundle which is totally tax-protected.

This graph doesn't show what you save on medical expenses, it doesn't show the allowances on your children's education, it doesn't show the travel allowances which cut down on vacation costs, it doesn't show the retirement benefits you may accumulate.

What it does show is that you have the chance of a lifetime to save a really important amount of money.

A sensible way to check out the new lifestyle

Everyone in Saudi Arabia lives within the letter of the local law. (No alcohol, for instance.)

But the Americans and Canadians eat steak and french fries, they go golfing and sailing and water-skiing, they tend their nice suburban houses.

While the lifestyle is easy, sometimes living so far away from relatives and friends can be difficult for some. That's why we've begun a new policy. The Aramco overseas tryout.

If you don't want to move your whole family over at once, come and work for us on bachelor status for one year. We'll fly you home three times so you can keep the family informed about your adjustment to life in Saudi Arabia. Then at year's end or sooner all of you can decide whether the life is for you or not.

Take on job challenges you thought you'd never see again

Aramco is the world's largest oil-producing company. So the job opportunities for experienced engineers are boundless. You can stay within your specialty—or you can expand into new territories.

Here are the engineering job categories we're interviewing for right now: Project Management & Construction • Oil & Gas Operations • Facilities Planning • Corrosion Control • Inspection • Resources Planning • Exploration & Development • Maintenance

(PS. Our opportunities are open to qualified engineers of *all* ages.)

Interested? Call our 24-hour line any day: (713) 750-6965—if you wish, call toll-free, (800) 231-7577, Ext. 6965 between 7 A.M. and 5 P.M., Monday-Friday, Central Time.

If you prefer, send your résumé in full confidence or write for more information to: Aramco Services Company, Department ME0101ML04A, 1100 Milam Building, Houston, Texas 77002.

ARAMCO
SERVICES COMPANY

MECHANICAL ENGINEERING

VOLUME 103 NUMBER 1 JANUARY 1981 Editor, J. J. JAKLITSCH, JR.

as the president sees it

TURNING POINTS

Finch Resigns. Dr. Rogers B. Finch, executive director and secretary of ASME since 1972, resigned from this post last month. ASME has been very fortunate to have had the benefit of Rog's expertise and guidance during this period.

Rog's career in academia, both at MIT and RPI, included technical contributions as director of research departments, administrative and organizational talents as planning head, and international expertise through special assignments — one as director of a special technical and economic mission to Burma and another as chief of the division of university relations for the Peace Corps.

Rog came to us at a critical time when his planning skills were most valuable, at a time when his experience in the international arena was most needed. A participant at the 1970 Goals Conference, he later helped assemble a diverse group of ASME members to participate in the Century Two Convocation in 1978. His contributions at both of these conferences have helped lead ASME successfully into its present restructuring.

As an officer in numerous international and national associations, he has provided guidance that has vastly improved the workings of organizations that support the global partnership of engineers, encourage the engineer to play a more effective role in society, and improve the operation and management of nonprofit associations.

Rog is a highly respected member of the mechanical engineering profession and of the association community worldwide. It was with regret that the Council accepted this resignation, and on their behalf I extend to him our deep appreciation. A search committee is presently engaged in the selection of a new executive director.

Hydrolevel Update. On Nov. 24, 1980, the U.S. Court of Appeals for the Second Circuit rendered a decision in the Hydrolevel vs. ASME case. The decision came in two parts.

On the question of liability, the Court of Appeals affirmed the judgment of the lower court, holding that ASME had been an "unintentional" participant in anti-competitive acts directed against Hydrolevel. Specifically, the Court held that the acts of two volunteer members of ASME which were in furtherance of their own anti-competitive ends were enough to bring ASME into a conspiracy, even though these acts did nothing to further ASME's interests and their anti-competitive purpose was concealed from the Society.

On the matter of damages the Court of Appeals reversed the judgment of the lower court, finding the award to Hydrolevel of $7.5 million "grossly excessive." In directing a new trial on this issue, the court limited ASME's liability to the period from April 1971 to June 1972, which represented the time between the issuance and subsequent clarification of the ASME code interpretation which was used against Hydrolevel.

While this decision would no doubt result in a significant reduction in the amount of damages for which ASME would ultimately be held liable, it is, nevertheless, short of what we had hoped for. The effect of this decision on technical organizations such as ASME is this: We must bear the consequences of the acts of all of our members, even when those acts are not taken on our behalf or in furtherance of our interests, and the true motives of the individual members are concealed from us. To place such a burden on voluntary, nonprofit, public-service organizations like ASME seems unwarranted and unfair. We have, therefore, petitioned for a rehearing in this matter.

Since this case began, it has been closely followed by our sister societies and other codes and standards writing organizations. These groups are ready to stand with us in support of our belief that justice will be done only when this decision is completely overturned.

C. E. Jones

C. E. JONES
President ASME

Energyscope

Fritz Hirschfeld

Nuclear Equipment Data Bank

An Equipment Qualification Data Bank (EQDB) is being established to provide a clearinghouse for information documenting the ability of nuclear power plant equipment to function under stress. The EQDB will focus on safety-related electrical equipment. It will provide information on the equipment's ability to function under normal wear (aging) and under potential accident conditions—such as a high-energy-line break or a loss-of-coolant type accident. A feasibility study funded by the Electrical Power Research Institute (EPRI) has shown that such a computerized system could assist the utility industry by reducing the difficulty and the cost of keeping up with the expanding scope of testing, analysis, and associated documentation that is presently required of nuclear plant operators.

Compilation of the data system has been started by the Florida Div. of the NUS Corp. under contract to EPRI. The EQDB is expected to become operational by the end of 1980. The new data bank will store all the available summary qualification data for electrical equipment in operating plants, plants under construction, and plants being designed. Generic data available from equipment manufacturers will also be stored. The summary data—retrievable by users via remote terminals as well as in regularly issued quarterly reports—will include equipment identifiers, environmental parameters, qualification test parameters, and sources of documentation. The EQDB should be particularly useful to utilities, architect-engineers, test laboratories, and equipment manufacturers.

Artificial Reefs from Coal Wastes

An artificial reef consisting of 500 tons (450 t) of wastes from coal-fired power plants was recently placed in the Atlantic Ocean near Fire Island, N.Y. As part of a five-year program sponsored by the Electric Power Research Institute, the reef is expected to enhance biological productivity and sport fishing opportunities in the area, and thus demonstrate a promising new technique for the safe and economic disposal of large quantities of coal wastes. In earlier stages of the project, tests were conducted to show that fly ash and sludge from stack gas scrubbers could be cast into concrete-like blocks. Underwater experiments were also carried out on a limited number of blocks to make sure that no toxic substances leached into the environment. The current full-scale effort will help prove environmental suitability and commercial feasibility.

The blocks being used are 8 in. (20 cm) on a side and 16 in. (40 cm) long and have been fabricated in a conventional concrete block plant. Some 15,000 blocks—each weighing 60 to 70 lb (27–32 kg)—were placed in ocean waters 65 ft (20 m) deep, 3 mi (5 km) from Fire Island off Long Island's south shore. The submerged reef is about 12 ft (4 m) high and has purposely been constructed with irregular contours to provide hiding places for small fish. Periodic surveys of the reef will be made by scientists from the Marine Science Research Center of the State University of New York at Stony Brook during the next several years. The marine experts will study biological colonization and will monitor the stability of the blocks. It is believed that coal waste blocks will remain far more stable than most of the materials that have been previously tried in artificial reefs.

A Liability to an Asset

A project by the Department of Energy, the Westinghouse Electric Corp., and the Bethlehem Mines Corp. has begun to channel potentially explosive methane gas out of the coal seam and into a nearby power plant. The effort is part of DOE's program to demonstrate a way of tapping the almost 100 billion cu ft (2.8 billion m^3) of methane gas that escapes, or is vented, from U.S. mines annually. Capturing the gas vented as a safety precaution from coal deposits has previously been considered too expensive to be worthwhile. But with the rise in energy prices, engineers working under a federal contract and in cooperation with the Commonwealth of Pennsylvania began in 1977 to study potential sites for a first-of-its-kind demonstration to convert this wasted resource into useful on-site energy.

The current test site is located at the Marianna No. 58 Mine near Washington, Pa. A 7500-ft-long (2300-m) pipeline was constructed from a drainage well in the coal seam to a power substation. Last summer (1980), after special gas compressor equipment was brought in, final connections were made to tie in the generator to the Bethlehem mine power grid. The system is providing roughly 400 kW of electricity from a gas flow of 240,000 cu ft/day (6800 m^3/day). This represents about 25 percent of the energy used in the mine's ventilation system and about 5 percent of the total underground mine electrical requirements. If this prototype test continues to prove successful, future applications at other sites might increase the gas flow by incorporating additional drainage wells.

K-Fuel

Two feasibility study grants have been given by the Department of Energy for a new alternative energy source known as K-Fuel. The grants went to Edward Koppelman of Encino, Calif. ($732,400), for a feasibility study to convert wood waste and peat into K-Fuel at a site in Maine; and to the Pullman Swindell division of Pullman, Inc., Pittsburgh ($1,782,800), for a feasibility study to convert wood into K-Fuel in a projected plant in northern California. Koppelman is the developer of K-Fuel. Both grants are contingent on grantees providing cost-sharing funds. The Maine study will develop technical, economic, and environmental information to prepare for the design and construction of a plant to produce 30,000 tons of K-Fuel per year. It would be used primarily by the Central Main Power Co. (CMP) to slurry with oil—replacing about 30 percent of CMP's dependence on imported fuel. The Pullman Swindell study will develop similar information for a plant in northern California to produce up to 60,000 tons/yr of K-Fuel. The Koppelman Process for K-Fuel—developed and tested through the pilot-plant stage in the Menlo Park, Calif., chemical and engineering laboratories of SRI International—has been shown to add between 30 percent and serveral hundred percent to the heating value of a wide range of low-grade carbonaceous or cellulosic materials, such as wood waste, peat, lignite, agricultural wastes, and marine biomass. Through an advanced form of pyrolysis, a reactor restructures the chemical composition of feedstock under controlled high temperatures and pressures. Within a period of 5 to 15 min in the reactor, K-Fuel—which resembles coal—is produced.

A Role for Boeing in Coal

Boeing Services International, Cocoa Beach, Fla., a subsidiary of the Boeing Co., has been selected to operate the Department of Energy's recently completed simulated coal mining equipment test facility near Pittsburgh. DOE and Boeing Services will now negotiate a contract for the latter to support and maintain the test facility for three years. An option also exists for a two-year contract extension. The total cost of the undertaking is estimated to be in the range of $8 million. The $25 million complex is expected to be the focal point in DOE's program for assisting the mining industry in developing improved underground mining equipment.

Located at the DOE Mining Technology Center in Bruceton, Pa., the test facility simulates conditions typical of an underground mine. DOE will use the installation to evaluate new equipment for coal cutting, roof support, and hydraulic coal transport. Also, by changing the pattern of movable "coal" walls, the complex can be employed to test the maneuverability of novel mining tools and techniques developed in research programs of DOE, other federal agencies, and private industry. And by proving coal mining machinery in a controlled but realistic environment, DOE hopes to reduce the time and expense involved in introducing safer and more efficient mining products into the marketplace.

Catalyst "Whiskers"

Badger Energy, Inc., a subsidiary of the Raytheon Co., has been awarded a contract by the University of Virginia in Charlottesville to assist in the further development of catalysts and catalyst supports in the coal-to-methanol process. The prime contract with the Department of Energy in Oak Ridge, Tenn., calls for improvements in the methanol synthesis step in converting coal to methanol by developing desirable catalyst characteristics and design features. The catalyst supports — known as "whiskers" because of their shape — were originally developed by Dr. Herman Schladitz in West Germany. The catalysts may find wide applications in the synthetic fuels industry and represent a relevant extension to Badger Energy's previous contract with DOE for a conceptual design of a coal-to-methanol-to-gasoline plant.

Alcohol Fuel Vehicle Testing

The California Energy Commission reports that the state is conducting the nation's largest test of straight alcohol fuels in vehicles. Both ethyl and methyl alcohol are being tested in three separate fleets of vehicles. According to the CEC, the first of the vehicle fleets consists of nine Ford Pintos. The Pintos have been modified to run on 100-percent ethanol fuel and will demonstrate the minimum engineering modifications that are needed to operate on pure alcohol fuels. Fleet 2 will consist of 25 Volkswagen Rabbits factory-produced to burn alcohol. Twelve will run on methanol and 12 on ethanol, with one gasoline-powered vehicle for research control. These will be designed not only to burn pure alcohol but also to meet California's 1982 emission standards and the 1985 federal fuel economy standards of 27.5 mpg (11.5 km/L). Fleet 3 will consist of 25 to 50 cars to be delivered by a major American manufacturer, and like Fleet 2, they will be factory-modified to operate on alcohol. Los Angeles County will establish multiple fueling stations throughout its jurisdiction and the fleet will test alcohol use under rigorous operational conditions in the most environmentally restrictive air quality basin in the U.S.

Blended Coal

A recipe that calls for blending specified quantites of low-sulfur coal with high-sulfur coal and then burning the mixture at optimum efficiency and with acceptable emissions is the latest innovation at the Consumer Power Co.'s B. C. Cobb generating plant in Muskegon, Mich. The problem for the utility was how to burn the lowest-cost fuel and yet stay within the Environmental Protection Agency's sulfur dioxide emission standards. The answer was to install new coal handling equipment — at an outlay of about $2 million — to blend high- and low-sulfur coals. A significant dollar saving is now expected because of the Cobb plant's unique ability to accommodate lower-cost fuel mixtures.

A dockside hopper, conveyor, and stacker were erected at the plant to receive the coal barge shipments. The stacker allows high- and low-sulfur coals to be stored in separate piles. This prevents uncontrolled mixing of the two kinds of coal, which would result in an unknown sulfur content. Bulldozers push the coal from the respective piles onto separate conveyors for the high- and low-sulfur coals. The conveyors are equipped with automatic speed regulators and scales that carefully control and adjust the blending procedure. By taking advantage of the flexibility of this coal blending conveyor installation, the coal mixtures can be quickly changed as needed to maintain the sulfur-dioxide emission limits.

Batteries for Peak Loads

By 1985, a battery system that is expected to be the world's largest will be helping utilities find ways to manage their peak load demands more economically and efficiently. The undertaking is being jointly funded by the Electric Power Research Institute, the Department of Energy, and two Michigan power cooperatives — the Wolverine Electric Cooperative of Big Rapids and the Northern Michigan Electric Cooperative of Boyne City. The 6-million-lb (2.7-million-kg) lead acid battery complex, which will cover half an acre (0.2 hectare) will be constructed as part of a $20.3 million storage battery electric energy demonstration (SBEED) program. The facility will be located in Hersey, Mich., north of Grand Rapids.

The two cooperatives will design, build, and test the SBEED plant to demonstrate the feasibility of operating a commercial-scale battery energy storage unit for utility use during peak demand periods. This peak demand is usually met by burning high-cost oil or gas. The battery array for SBEED will cost $8.5 million and will consist of 2280 battery modules. It will be capable of storing up to 30 MWh of electricity. DOE will contribute $11.3 million to the capital cost; the two power cooperatives will advance $8 million; and EPRI will provide $1 million. Completion of the project design is scheduled for 1981; construction for 1984; and the beginning of commercial operation for 1985.

our glorious past:
an ASME Centennial Profile

William F. Durand

— Dean of American Engineers

FRITZ HIRSCHFELD[1]
San Francisco, Calif.

It has often been said that old age is cruel. In the case of Dr. William F. Durand — as he passed his 99th birthday in 1958 virtually alone and helplessly incapacitated in a two-room suite at the Mohawk Hotel in Brooklyn, N.Y. — it was doubly pathetic and ironic as well. For a man who had devoted his entire professional life — over 75 years — to engineering, education, and public service; who had a closetful of honors, awards, and commendations to acknowledge his many valuable contributions; and who, during his active years, had rubbed shoulders with the elite of the world; now, in his final days to be forgotten and neglected was tragic beyond words. Few of his past associates and friends apparently had time or interest anymore in this remarkable personality. But to their everlasting credit, the staff and some of the members of ASME remembered their colleague and past president and tried to bring a little comfort and joy into his otherwise drab existence. The following is excerpted from the 1958 minutes of the June 14, 16, and 17 Council Meetings of ASME:

"*Hospitalization.* W. F. Durand, a member of the Society since 1883 and now 99 years of age has been incapacitated for the past year, during which time the Society has expended certain monies to provide him with flowers, fruits, candy, and drives in the open air when his physician permitted. Because of the constant nursing he has required, his personal finances are almost exhausted. Hospitalization has been recommended. The question of financing his hospitalization was presented. The Council

VOTED: To have staff take steps to obtain funds from Dr. Durand's friends for his care for a period of one year."

It would be embarrassing to elaborate on the lack of response to the personal letters of solicitation that were sent out by ASME asking for modest support for Dr. Durand. Suffice it to say that barely $600 was raised. Nevertheless, the Society took it upon itself to see that the old gentleman always had fresh-cut flowers on his desk; that he was visited regularly; that he was taken on regular outings; that his birthdays were not forgotten; that his air-conditioner was properly repaired; and that he was well looked after and comfortable in the numerous small ways that are so important to the aged and handicapped. Fortunately, Dr. Durand was spared the further indignities of poverty and indifference, for he died in August 1958 after a short illness.

Durand's Fruitful Careers. For the greatest part of his 99-plus years, Durand lived a full and active life, and was productive in at least five different careers. His professional training began at the U.S. Naval Academy in Annapolis, from which he graduated with honors in 1880 as an

[1]Contributing Editor, ME. Mem. ASME.

General Carl Spaatz, chief of staff of the U.S. Air Force, presenting the Medal for Merit to Dr. Durand in recognition of his services as a former member and chairman of the National Advisory Committee for Aeronautics.

On his 98th birthday the "Dean of American Engineering" received a plaque of commendation from Frank Peer Beal, left, president of the Community Councils of the City of New York, and Col. C. E. Davies, secretary of ASME.

engineer-cadet. During the next seven years he served in the newly formed engineering corps of the Navy and, without realizing it at the time, laid the groundwork for his subsequent pioneering investigations in the field of marine engineering. When he resigned from the Navy in 1888, he had his next goal in mind: His heart was set on becoming an educator!

After earning a Ph.D. in physics at Lafayette College in Pennsylvania, Durand started on his lifelong vocation as an engineering educator by winning an appointment to the position of professor of mechanical engineering at Michigan State College. In 1891 he moved to Cornell University to work with Dr. Robert H. Thurston (the first president of ASME) at Sibley College and to take charge of Cornell's Graduate School of Marine Engineering and Naval Architecture. After Thurston died of a heart attack in October 1903, Durand decided to accept an invitation to join the faculty at Stanford University, where he soon became the head of the Department of Mechanical Engineering. Durand was 45 years old when he went to California in 1904, and 20 years later he was officially retired — by age limitation — to the status of professor emeritus. But his active connection with Stanford — in his emeritus capacity — continued until well after World War II.

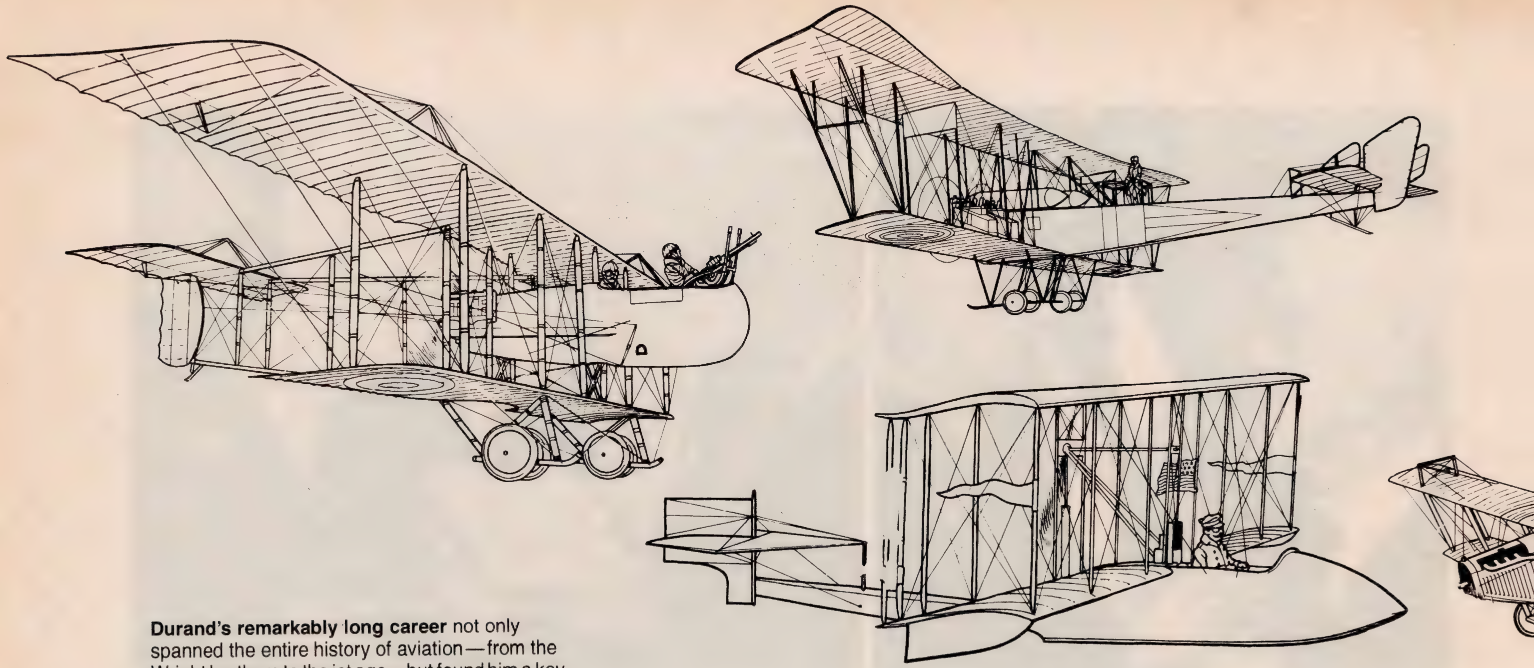
A third career encompassed his work as an inventor, innovative researcher, and prolific author. While still at Cornell, Durand introduced logarithmic cross-section paper to the engineering world; published in the technical press an article developing the theory of a planimeter for averaging the ordinates of a diagram plotted in radial coordinates; and, by using small experimental ship models in a hydraulic tank, undertook a detailed and extended study of the action of the marine screw propeller. In 1898 he published his screw propeller findings in a book — *The Resistance and Propulsion of Ships* — that for the first time rationalized design procedures and eliminated most of the guesswork in designing marine propellers. This basic volume brought Durand immediate international acclaim. And in 1899, his peers in the American Society of Naval Engineers recognized his unique contributions to the art of marine engineering by awarding him that society's gold medal.

Durand's research in the embryonic field of fluid mechanics broadened when he relocated to Stanford. But now his interest focused on aircraft propulsion systems. Following World War I, Durand designed and built on the Stanford campus one of the first private wind tunnels in the country, and for approximately 14 years conducted systematic tests on more than 100 airplane propeller designs. The evolution of the science of fluid mechanics and its particular application to the new discipline of aeronautics led Durand to spearhead the effort to coax and encourage the leading scientists in the U.S. and abroad to produce written summaries of their findings in their respective specialties. With two sections that he wrote himself, he edited and combined them into a 20-part, six-volume encyclopedic library — *Aerodynamic Theory* (1934–35) — covering the entire field. It was and remains one of the authoritative texts in aeronautics.

In the Nation's Service. The arena that would occupy much of Durand's life, especially in his later years, was that of public service. When World War I began in 1914 — and while Durand was still teaching at Stanford — a move was made in Washington to establish a national aeronautical laboratory. Durand, because of his reputation in fluid mechanics and his pioneering research on both marine and aircraft propulsion systems, was invited to join in this undertaking. He was one of the original 12 members appointed by President Wilson to the National Advisory Committee for Aeronautics when the NACA was brought into existence in 1915, and was its World War I chairman. In all, Durand was a member of the NACA for 23 years, serving from 1915 through 1933, and again during World War II, from 1941 through 1945.

Durand's responsibility as NACA chairman — though he was working without compensation — became so great after the U.S. entered the war against Germany in 1917 that he found it necessary to obtain a leave of absence from Stanford in order to devote full time to his activities on behalf of the government. Upon his arrival in Washington, Durand was faced with an aircraft industry in disarray due to widespread patent litigation. As chairman of the NACA Special Committee on Patents, he evolved a cross-licensing agreement that resulted in an enduring patent peace among the quarreling aero interests. He organized America's first training program for military aviators and directed to various agencies of the government the thousands of aeronautical inventions that were submitted to Washington for consideration in the course of the war. He took the lead in designing the NACA's first wind tunnel at its Langley Aeronautical Laboratory at Langley Field, Va.

In addition to giving active direction to the NACA's research program, which later was credited with making the U.S. a world leader in aeronautical science, Durand



Durand's remarkably long career not only spanned the entire history of aviation—from the Wright brothers to the jet age—but found him a key participant in every phase of its development.

participated in the work of the committees of the National Academy of Sciences and of its then new National Research Council. He was vice chairman of the latter's Engineering Committee and sat on its Committees for the Detection of Submarines by Acoustic Methods and for the Production of Helium. Late in 1917, while still chairman of the NACA, he carried out a special assignment as scientific attaché at the American embassy in Paris in order to improve and enlarge the applications of science to the military problems of World War I.

In the period between the wars — 1918 to 1941—Durand was busier than ever on numerous public service commitments. For instance, he was asked by Daniel Guggenheim to become a trustee of the Guggenheim Fund for the Promotion of Aeronautics, and he took on that responsibility during the active life of the fund, 1925–30. In 1925 Durand was appointed by President Coolidge as a member of the Aircraft Board, whose recommendations were influential in shaping the future course of aviation in America. In 1935 he was named chairman of a committee appointed under the National Academy of Sciences at the request of the Secretary of the Navy and charged with making a general study of the broad question of the airship (dirigible) with reference to its promise of useful service, either commercial or military.

For a time, his principal interest became the problems of steam and hydraulic power plants. This led to his retention as a consultant by the Bureau of Reclamation and by various state and municipal enterprises in connection with the Boulder, Shasta, and Grand Coulee Dam projects, the Hetch Hetchy power development for the City of San Francisco, the power developments along the line of the Owens River Aqueduct for the City of Los Angeles, and the St. Lawrence power development for the State of New York, among other projects.

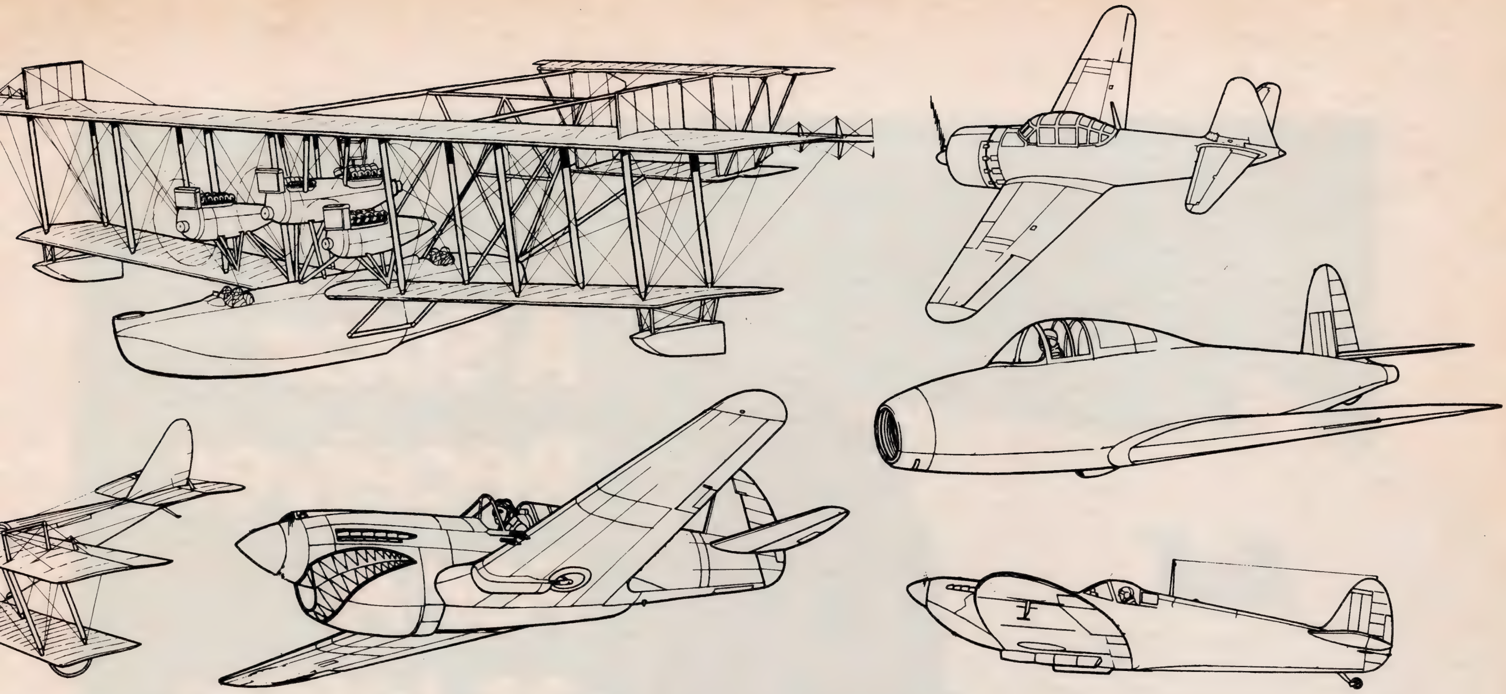
In addition to technical writing in book form (including a biography of his former mentor at Cornell, Robert H. Thurston), Durand was a frequent contributor to engineering and scientific literature through special papers, reports, and articles published in the proceedings of technical societies and in the technical press. He wrote on subjects as diverse as aeronautics, biology, fluid mechanics, marine engineering, mathematics, mechanical engineering, and propellers.

Recognition. Durand's honors were many. In 1935 he was awarded one of the highest honors for an engineer — the Guggenheim Medal — "for notable achievement as a pioneer in laboratory research and theory of aeronautics and for distinguished contribution to the theory and development of aircraft propellers." That same year he was awarded the John Fritz Gold Medal, bestowed by a board consisting of members from the national societies of civil, mechanical, mining, and electrical engineering. In this instance, selection was for "achievement in applied science, for distinguished service as an authority in hydrodynamic and aerodynamic science and its practical applications...an outstanding leader in research and engineering education." In 1938, the Franklin Institute awarded him its Franklin Medal in recognition of "his notable achievement as pioneer in laboratory research and theory of aerodynamics and of his diversified and distinguished contributions to the science of hydrodynamics and aerodynamics..."

The John J. Carty Gold Medal was presented to Dr. Durand in 1944 by the National Academy of Sciences. The citation —picturing the man—said: "In his profession, a versatile and creative engineer; among his colleagues, a wise and friendly counselor; before his students, a kindly and inspiring teacher; to the nation, a devoted and able servant." In 1954, ASME awarded Durand its Gold Medal for "his contributions in hydrodynamic and aerodynamic science and its practical application...(and) for his trustworthy advice to our government in the solution of many intricate problems in peace and during two world wars." In 1948, he was the first recipient of the Wright Brothers Memorial Trophy, awarded by the National Aeronautic Association for "significant public service of enduring value to aviation in the United States."

An ASME Leader. Durand had been a member of ASME since 1883 — three years after the Society had been founded — and had served it in many capacities. He presented his first paper, on the subject of the marine propeller, to ASME in 1893. When the San Francisco Section of the Society was organized in 1910, it was only natural that Durand should take a leadership role in its affairs. From 1911 to 1913 he was a vice president of ASME and was able to bring to the Council the point of view of members on the Pacific coast. In 1919–20, he served as chairman of the San Francisco Section. So keen was Durand's understanding of section affairs that, in 1941, when the Council wanted to outline for the membership a statement of the aims and objectives of the Society, they asked Durand to prepare it. In that dissertation, Durand paid high tribute to the local sections and pointed out their potential for contributing growth and vitality to the Society.

Durand was elected president of ASME in 1925. Although his residence was in California, he moved to the east temporar-



ily and made the ASME headquarters in New York his base of operations during his term of service. From there he effectively carried out his administrative duties. His travel schedule heavily emphasized visits to local sections and student branches. His perspectives were humanitarian as well as technical. In his presidential address, "The Engineer in Civilization," he called for engineers and engineering societies to recognize their obligations and opportunities for service in the broad fields of humanity.

Durand's memberships on committees of the Society and on joint bodies as a representative of ASME were large in number and fruitful in accomplishment. During the World Power Conference in 1936, for example, Durand served as vice chairman of the American National Committee and as chairman of the Conference, presiding at the important sessions. At the close of the Conference, he was elected its president. He represented the Society on the International Electrotechnical Commission and directed the committee sessions in New York in 1926, in Bellagio in 1927, and in London in 1929. From 1927 to 1932, he served as director of the Secretariat on Hydraulic Turbines and as chairman of the group of U.S. Advisors on Hydraulic Turbines. In these international gatherings, his linguistic ability was a definite plus in making the meetings successful. In 1930, when the Society celebrated its 50th anniversary in New York and Washington, Durand acted as toastmaster at a memorable banquet in the Mayflower Hotel at which Herbert Hoover, then President of the U.S., was the principal speaker. The final and highest honor that the Society could confer on Durand took place in 1934, when he was made an Honorary Member of ASME.

In 1941, when Durand was 82 years old, he was called from retirement by President Roosevelt and was reappointed a member of the NACA in order to become chairman of the NACA's Special Committee on Jet Propulsion. In this capacity, he was the key man in originating research and in the initial guidance of industry in the development of the turbojet engine. When one recalls that Durand grew up in the age of the transition from sailing ships to steam-driven vessels, it was an astonishing achievement to be able to play a significant part in presiding over the jet age. After he had completed his work and the war was over, Durand received the following letter from President Truman:

My dear Dr. Durand:

I accept, with regret, your resignation as a member of the National Advisory Committee for Aeronautics, dated July 2, 1945, in which you state it is to be effective when transmitted. Chairman Hunsaker has just sent it to me.

You have had an exceptionally long and distinguished career in many fields of scientific endeavor, having been one of the original members of the NACA, appointed by President Wilson in 1915, and having served as Chairman of that Committee in World War I. After retiring in 1933 you were recalled by President Franklin D. Roosevelt to the service of your country in 1941 and reappointed a member of the NACA. As Chairman of the new Special Committee on Jet Propulsion, you organized with eminent success the research and development program in the important new field of jet propulsion of aircraft.

With the termination of the wars with the Axis, you take with you into honored retirement, at 86 years of age, the consciousness of substantial contributions to the public interest, and particularly to the advancement of the science of aeronautics. I wish you many years of peace and happiness, in which you may enjoy the continuing fruits of your labors.

Very sincerely yours,
Harry Truman

Durand's wife of 67 years died in 1950. As he wrote in his autobiography (*Adventures in the Navy, in Education, Science, Engineering, and in War,* New York, 1953, p. 163):

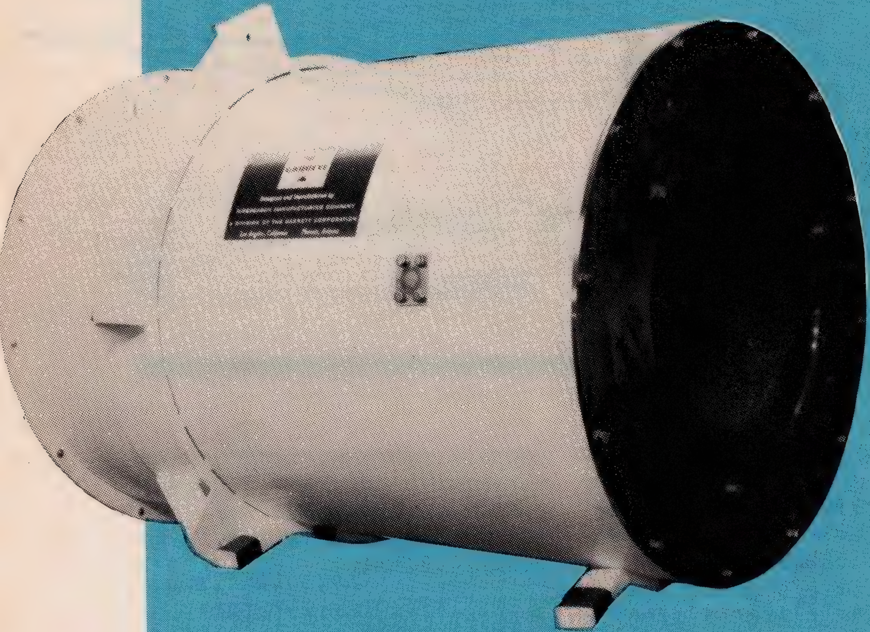
Left alone in California, except for a niece in Los Angeles and with children, grandchildren and great-grandchildren in the East, I decided to shift my base from Stanford to Brooklyn, N.Y., where I could be in ready contact with members of my family.

This plan I carried out, leaving Stanford on May 9, 1951, spending ten days saying goodbye in Los Angeles, one day in Albuquerque, New Mexico, and reaching New York on May 23. Here I am comfortably established in an apartment hotel with the residence of my son a short three-minutes' walk distant, one grandson and his family in central New York State and another with his family in New Jersey.

And so the days are passing by.

Now how it came to pass that Dr. Durand found himself in the sad predicament described in the opening part of this article cannot be adequately explained at this distance and with the information at hand. But whatever the explanations, the fact is that in his last years Durand urgently needed outside help and the Society and its members heard the call and came to his assistance. There may be a small moral in this: ASME is not an impersonal institution — it also has a heart!

A Solar Receiver For A 25-kW(e) Gas Turbine



Air Brayton solar receiver.

M. GREEVEN[1], M. COOMBS[2], and J. EASTWOOD[3]
AiResearch Manufacturing Co. of California, Torrance, Calif.

A solar receiver turbine under development for the Department of Energy, under contract to the Jet Propulsion Laboratory, is designed to be used with a single-point-focus, parabolic concentrator. The receiver accepts the concentrated solar radiation and uses it to heat the working gas of a small, open-cycle gas turbine to about 1500° F (816° C). The receiver employs a high-efficiency, metallic plate-fin heat transfer surface to effect this energy transfer.

As part of the national solar energy program, the Department of Energy is pursuing several approaches to generating electrical power from solar energy. One of these approaches involves the point-focusing distributed system, which comprises one or more independent power-producing modules. Each module consists of a large parabolic concentrator that tracks the sun and focuses the solar energy into a receiver aperture located at the focal point of the concentrator, Fig. 1. The receiver cavity accepts this highly concentrated solar energy and transfers a large percentage of it to the working fluid of a power cycle. The Jet Propulsion Laboratory (JPL) is supporting DOE by developing the technology required to demonstrate and characterize systems of this type that will employ various candidate power cycles.

Under contract to JPL, AiResearch is developing a solar receiver for a 25-kW(e) gas turbine engine. This receiver will be used in a point-focusing system. The gas turbine power system, Fig. 2, is termed a hybrid solar/chemical system because it employs a chemical combustor in series with the receiver. This is done so that the power system can use either solar or chemical energy or a combination of the two.

Design Requirements

The solar input is 85 kW. This energy is used to heat the working gas (air) of the highly recuperated open-cycle gas turbine engine from 1049 to 1500°F (565 to 816°C). The solar input is provided by a 36-ft-dia (11-m) parabolic dish concentrator that has an assumed slope error of 1 milliradian, as well as a tracking error

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[1] Project Engineer.
[2] Senior Technical Specialist.
[3] Senior Development Engineer. Assoc. Mem. ASME.

of zero. (Slope error is a measure of the surface inaccuracies of the actual concentrator compared to that of an ideal surface.) In addition to the performance requirements, the environmental conditions included a 30-mph (48-km/h) steady-state wind with a 20-percent gust factor; temperature extremes of 0 to 125°F (−18 to 52°C); humidity extremes of 0 to 100 percent; blowing dust; etc. Survival environmental conditions such as 100-mph (160-km/h) winds, seismic loads up to 3 g, and snow and ice loads, were also imposed.

The Receiver

The major elements of the receiver are shown in Fig. 3. The outer cylindrical case is approximately 30 in. (0.75 m) in dia by 46 in. (1.2 m) long. Mounting brackets attached to the surface of the case mate to a mounting ring that is part of the concentrator structure. A second inner cylindrical assembly forms the receiver cavity. Approximately 4.5 in. (0.11 m) of insulation is placed between the outer case and inner cavity. The wall of the receiver cavity consists of a single-sandwich, plate-fin heat exchanger panel. Air from the recuperator is ducted to a torodial manifold at the bottom of the panel, where it flows up the annular passage that defines the vertical walls of the cylindrical cavity. It is subsequently collected in another torodial manifold at the top of the cavity assembly, where it is ducted to the turbine inlet.

The single-sandwich cylindrical panel contains a high-density offset fin matrix. This matrix has 12 fins/in. (4.72 fins/cm), which are 0.50 in. (1.27 cm) high, 0.004 in. (0.01 cm) thick, with a 0.50-in. (1.27-cm) offset length. The fins are brazed to the two metal sheets that form the cylindrical panel. The heat exchanger is made from Inconel 625 material. The receiver is positioned so the focal point of the concentrator is located at the plane of the receiver aperture. The aperture end is a cone assembly made from silicon carbide, which forms a circular opening at the bottom of the cylindrical cavity. The top surface of the cavity is an uncooled circular ceramic plate, also made of silicon carbide. This circular plate is supported by insulated standoffs to the outer casing. An annular plate made of Inconel 625 is attached to the bottom of the casing and supports the ceramic aperture cone.

Optical and Thermal Design

Analysis of concentration-type solar receivers requires that optical as well as thermal properties be considered. This is because the solar receiver is directly coupled to the optical system. The optical input to the receiver depends on the detailed characteristics of the receiver, the concentrator, and the orientation of these two major elements. Evaluation of the solar flux into the receiver is done with a model in which the sun is treated as an extended, finite-sized source. The resultant radiation transfer can be accurately analyzed by using cones, rather than optical rays, as the basic description for energy transport.

Incident solar flux distributions on the receiver cavity walls, as generated by the mathematical solar simulator, are presented in Fig. 4 for the 85-kW(th) design point case. In equation form, the solar concentration ratio is defined as

Fig. 1 Solar point-focusing distributed electric power system.

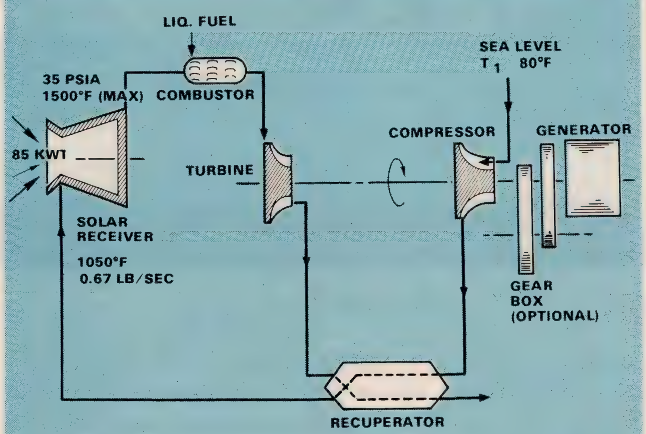

Fig. 2 Hybrid solar/chemical gas turbine system schematic.

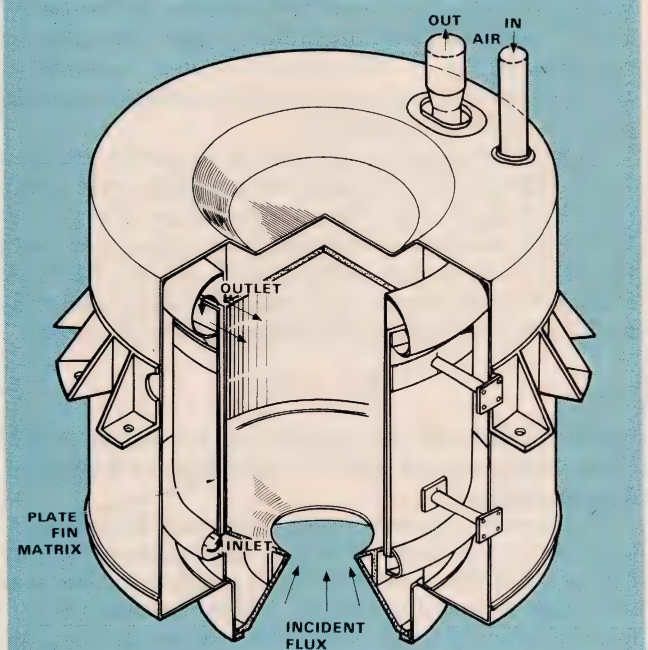

Fig. 3 Air Brayton solar receiver.

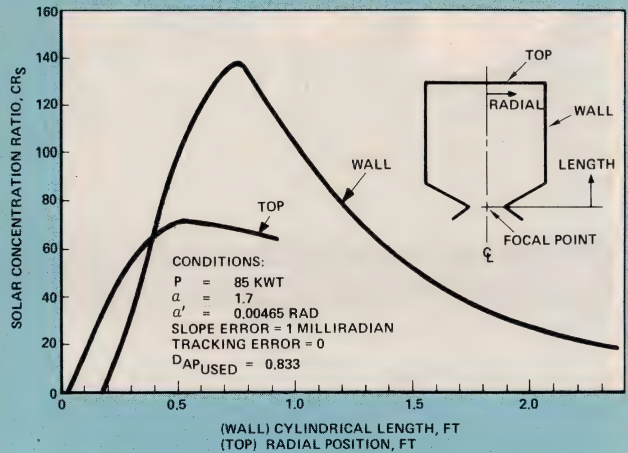

Fig. 4 Cavity wall solar concentration ratio distribution.

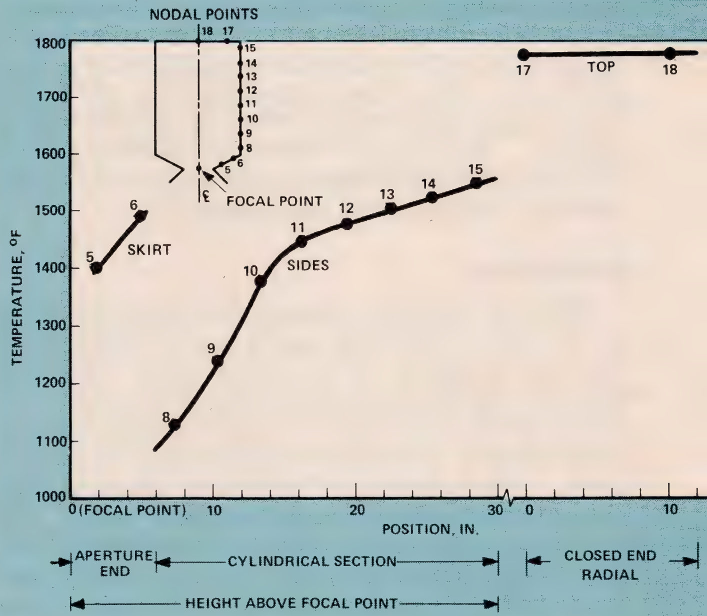

Fig. 5 Steady-state cavity wall temperature distribution for 85-kW(th) design point case.

$$CR_S \triangleq Q''/\rho \cdot S'' \cdot \eta_{coll} \tag{1}$$

where Q'' is the heat flux impinging on the surface, ρ is the concentrator reflectivity, S'' is the local solar insolation, and η_{coll} is the aperture/concentrator collector efficiency.

In Fig. 4, the cylindrical cavity wall solar concentration ratio is shown as a function of cylinder length, as measured from the focal point. The solar concentration ratio for the closed end (top) is shown as a function of radial position, as measured from the receiver centerline. Conditions used in obtaining these plots also are indicated in Fig. 4. This type of incident radiant flux information is a required input for a detailed thermal analysis of the solar receiver.

Thermal analysis of the receiver is performed by a finite-element thermal analyzer computer code developed by AiResearch. The cavity wall incident flux information is input to the computer code, along with fluid flow data and geometry specifications. Multiple reflections and reradiation characteristics inside the cavity are calculated by the following relationship:

$$\underline{B} = A^{-1}\underline{C} \tag{3}$$

where $\underline{B}$ is the radiosity column matrix, A is an $N \times N$ characteristic matrix, and $\underline{C}$ is a temperature-dependent column matrix.

Equation 3 assumes a gray body and diffuse emittance and reflections. For solar applications, the gray body assumption is acceptable for rough metal surfaces with high emissivities (~0.8). This is because the difference between the solar absorption and the metallic emissivity is relatively small for metallic surfaces with high emissivities.

The net heat flux lost from the i^{th} surface is obtained from the following equation:

$$Q_i'' = \frac{1-\epsilon_i}{\epsilon_i}(E_{b_i} - B_i) \tag{4}$$

where ϵ is the emissivity, E_b is the black body emissive power, and Q'' is the net heat flux lost from the i^{th} surface.

The cavity wall temperature distribution resulting from a steady-state thermal analysis of the receiver design is shown in Fig. 5 for the three cavity sections—the aperture conical end (nodes 5 and 6), the cylindrical wall (nodes 8 through 15), and the closed end (nodes 17 and 18). A direct physical connection between the cylindrical section at both the aperture end and the closed end has been avoided, thereby eliminating large localized thermal gradients between these sections. Because the fluid is single phase and the inlet and outlet temperatures are fixed, and because a relatively high fluid heat transfer conductance (hA) exists, the wall temperature profile is controlled by the fluid temperature. Thus, minor variations in the concentrator performance (e.g., slope error = 2 mrad) will not significantly affect the cavity efficiency for the aperture size selected.

Aperture convection losses are accounted for by scaling test data in the literature for open-cavity type solar receivers. This procedure indicates that losses will amount to approximately 2 percent of the incident power for a 25-mph (40-km/h) wind condition.

The steady-state thermal analysis includes a complete nodal temperature distribution throughout the receiver, fluid temperature rise, fluid pressure drop, cavity efficiency, and an energy tabulation. Table 1 presents the energy bookkeeping summary and cavity efficiency calculation for the design point operating condition. In the energy bookkeeping summary, it should be noted that a 2-percent aperture convection loss is included. The cavity efficiency presented is defined as

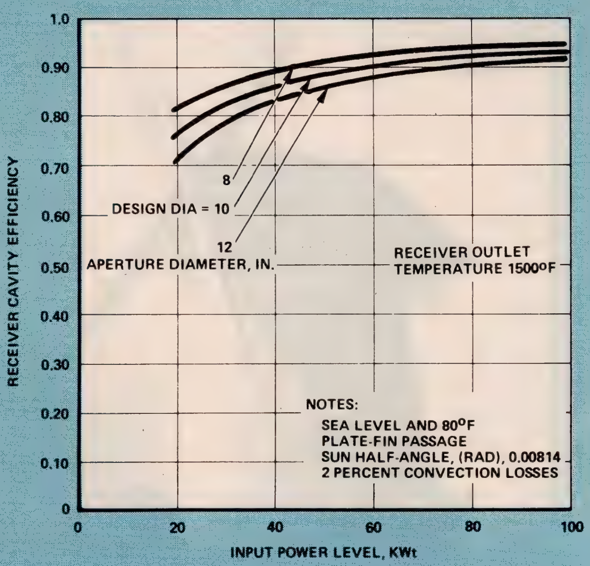

Fig. 6 Brayton solar receiver cavity efficiency as a function of power level.

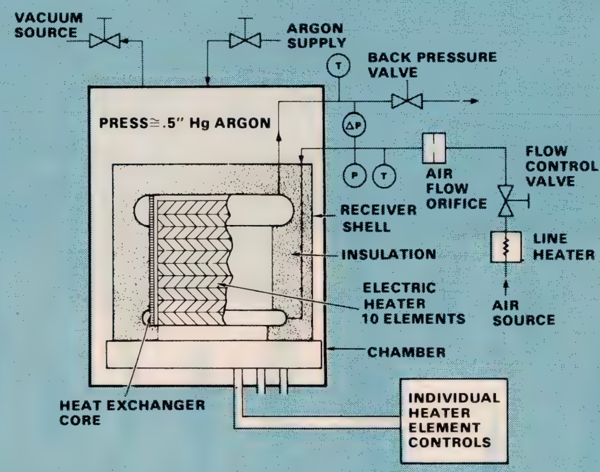

Fig. 7 Heat exchanger development test setup.

$$\eta_{cav} \triangleq \frac{\text{energy into fluid}}{\text{energy into aperture}} \tag{5}$$

This efficiency was calculated to be 0.925. Cavity efficiency as a function of thermal input energy for three different aperture sizes is shown in Fig. 6. Note that the smallest aperture consistent with the concentrator optics is the most desirable.

Structural Design

The receiver heat exchanger is designed to withstand an operating pressure of 38 psia (2.59 atm) at a maximum temperature of 1550°F (843°C) and a proof pressure of 65 psia (4.42 atm) at room temperature without yielding. The fins brazed between the inner and outer walls of the heat exchanger react to the internal pressure loads. The predicted life of the prototype heat exchanger unit is 6000 start/stop cycles or approximately 8 to 10 yr.

The cavity panel heat exchanger is attached to the outer casing by four radial tubes located at two locations along its length. The upper set of support tubes allows for radial thermal growth and the bottom set allows for both radial and axial thermal growth. The aperture cone is supported from the case with insulated standoffs, as is the circular top plate.

Bellows on the air-inlet and exit lines at the top of the receiver limit the loads that might be imposed on the heat exchanger from this source.

TABLE 1
Brayton Cycle Solar Receiver Performance

Thermal power level	85 kW(th) (nominal)
Design sun half-angle	0.007905 radian (slope error = 0.0573 deg, track error = 0 deg)
Actual sun half-angle	0.00465 radian
Incident solar flux	0.979 kW/m²
Concentrator reflectivity	0.86
Energy bookkeeping	
Total energy into cavity, kW(th) (percentage)	85.0 (100)
Energy to fluid, kW(th) (percentage)	78.6 (92.5)
Energy losses, kW(th) (percentage)	
Loss by radiation out aperture	3.62 (4.26)
Loss by convection out aperture[1]	1.70 (2.0)
Loss by radiation and convection from the outer surface	1.05 (1.24)
Cavity efficiency, percentage	92.5

[1]Assumed 2-percent loss due to aperture convection losses.

Test Program

As part of the development effort, one receiver heat exchanger with the appropriate ducting will be fabricated and assembled in the test device depicted in Fig. 7. A cylindrical electric heater is inserted in the test heat exchanger cavity. The heater consists of wire resistance elements arranged on the surface of the cylindrical heater. There are 10 separately controlled heating zones on the heater surface; this allows the imposition of the same net heat flux distribution on the heat exchanger wall that will be seen during operation with solar input. The assembly is installed in a low-pressure chamber that provides an argon cover gas for the electric heater assembly. Tests will be performed to obtain heat exchanger performance as well as to subject the heat exchanger to 500 startup and shutdown cycles.

Based on a paper contributed by the ASME Gas Turbine Division.

Wind: A Power Source for Forklift Trucks

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Marquette University, Milwaukee, Wis.

Wind has been a power source for at least a thousand years. Most familiar to us are the windmills of Holland and the rural windmills of the early 20th century. Over the past two centuries, however, because of economy and convenience, wind as an energy source has been eclipsed by electricity and gas. Now, with the energy crisis, wind is once again moving to the forefront and, in the case under discussion, in a domain heretofore reserved for electricity and gas—the factory. It is now being seriously considered as a source of energy to power several forklift trucks, an application here shown to be feasible even at moderate rates of inflation.

The decision involved in the purchase of a forklift truck has heretofore been simply a choice between electric or propane power. However, as the energy situation worsens and technical advances in the area of wind generation increase, the decision matrix takes on the added dimension of wind power. On-site studies to determine wind characteristics and forklift truck use patterns were conducted at Wisconsin Centrifugal Inc. of Waukesha, Wis. An economic analysis was then performed, and it showed that wind generation does indeed enter the decision matrix.

The 31-truck fleet of Wisconsin Centrifugal was monitored in order to establish their use patterns. The average hours of use per week are shown in Table 1. A 5000-lb-capacity (2300-kg) truck was chosen as the subject truck; see Fig. 1. The choice was made after evaluating the actual use of the individual trucks. The power consumption of this capacity truck is 1.2 gal/hr, or 2.7 kWh/h. The propane tanks have a capacity of 7.78 gal, or 6.5 hr of operation per tank. The battery of the electric trucks provides 34.56 kWh/charge of energy or 12.8 hr of operation between charges. Referring to Table 1, the maintenance department has four trucks, which are used an average of 16 hr/wk. This would require that one battery per day would have to be charged in order to keep the maintenance fleet operational.

Windmill Theory

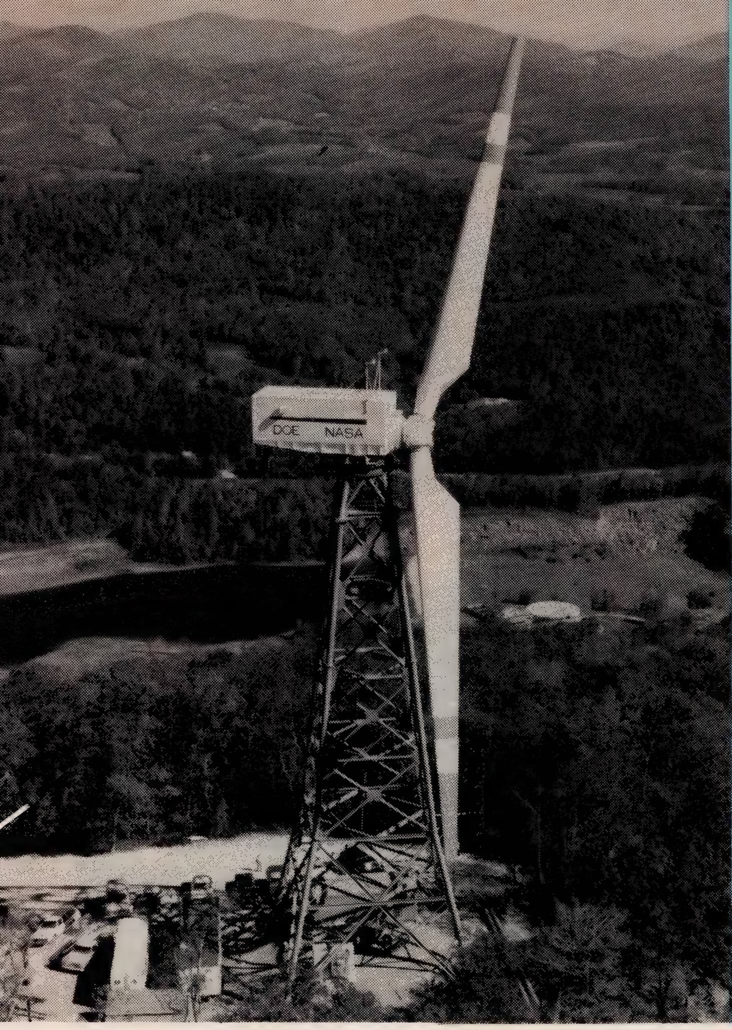
The usual device for energy extraction from the wind is the free-standing, horizontal-axis, propeller machine. Most of the developmental work has been done on these machines because their design parameters are best understood. The maximum power output for this type of machine was calculated using the Betz [1][3] momentum theory. This theory, combined with the efficiency assumptions of 80 percent for the windmill mechanism, 70 percent for the generator, and 85 percent for the battery, determines the maximum power output as

$$P(\mathrm{kW}) = (4.3587 \times 10^{-6})R^2V^3 \qquad (1)$$

where R = blade radius in feet, and V = free stream velocity in miles per hour.

Wisconsin Centrifugal Inc. of Waukesha, Wis., is located approximately 7 mi (11 km) to the west of Mil-

[1] Assistant Professor, Dept. of Mechanical Engineering.
[2] Assistant Professor, Accounting and Finance.
[3] Numbers in brackets designate References at end of article.



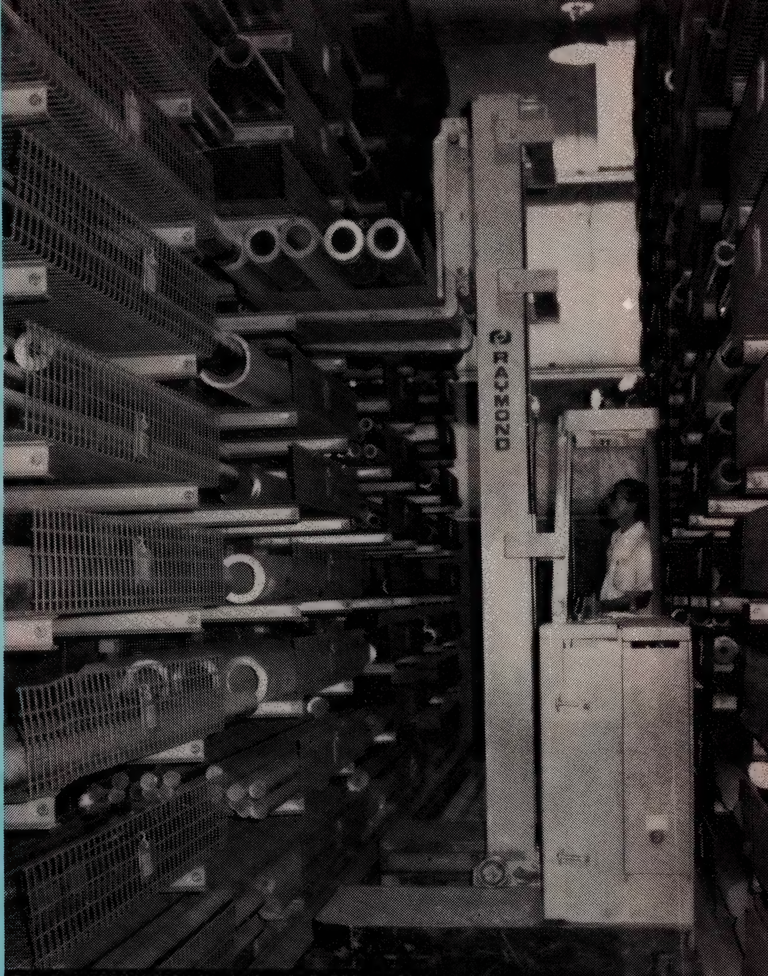


Fig. 1 A 5000-lb (2300-kg) electric forklift truck at work in the machine shop.

waukee, Fig. 2. A bluff exists to the south and southwest of the plant. This bluff, combined with the multilevel roof line, causes wind turbulence at wind levels close to the roof. A wind cup anemometer was installed 20 ft (6.1 m) above one of the roofs, which was not the highest in the immediate area. However, this site, indicated by (A), was chosen as the site for the wind generator. The highest point, (B), is located close to exhaust fans, which emit a flow that causes a turbulence, making it unfavorable as the site location for the generator. Even with these physical features, the site data compared favorably with those recorded by the U.S. Weather Bureau. Since the Weather Bureau data were compiled over a 10-yr period, they were used for the remainder of the study.

Figure 3 shows the percentage of time the wind is at a specified velocity. If this percentage of time is translated into hours per day, the energy in kilowatt-hours available can be calculated by rewriting Eq. 1 as follows:

$$\text{kWh/day} = \text{P(kW)} \times \text{hr} = (4.3587 \times 10^{-6})R^2 \sum_{A=1}^{N} V_i^3 t_i$$

where t_i = time at velocity i per day.

Using Golding's [2] information of a cut-in velocity of 6 mph (10 km/h) and a rated speed of 14 mph (23 km/h), Fig. 3 suggests a cut-out velocity of 20 mph (32 km/h). Two types of rotor control systems were considered [3]. The first would feather the blades or rotate the generator out of the wind at velocities of 20 mph (32 km/h) or greater. The second system would govern the rotor speed at wind velocities of 20 mph, therefore producing power at these higher speeds. The second system obviously produces more energy since winds above 20 mph occur approximately 15 percent of the time. However, this system produces large stresses at these velocities, depending on the machine size, which must be considered.

Equation 2 shows that an output of 20.3 kWh/day is produced by the second system with a 10-ft-radius (3-m) generator, 45.8 kWh/day with a 15-ft-radius (4.6-m) generator, and 81.4 kWh/day with a 20 ft-radius (6.1-m) generator. Since an average of 34.56 kWh/day is consumed by the electric truck, a 15-ft (4.6-m) generator was chosen for the site. Equation 1, combined with the average wind velocity of 12 mph (19 km/h) in Milwaukee, indicates a generator of 1.8 installed kilowatts. At an average cost of $1500 [4] per installed kilowatt, the cost of installation was set at $2700. The wind data indicate that August is the least windy month of the year. However, a generator of 15-ft (4.6-m) radius still produces 41.9 kWh/day during this month, which is well above the required 34.56 kWh/day.

As in all studies, there are factors other than economics that have an influence on the decision. The propane truck appears to be presently superior in an outdoor environment, whereas the electric truck is often favored for indoor use because of environmental considerations. The propane truck is favored for changing of fuel sources as a simple tank replacement is easily accomplished, while the battery of the electric truck must be recharged and is more difficult to manuever due to weight. The electric truck appears to have a place at Wisconsin Centrifugal. The trucks in the maintenance department are used indoors and, due to the dust

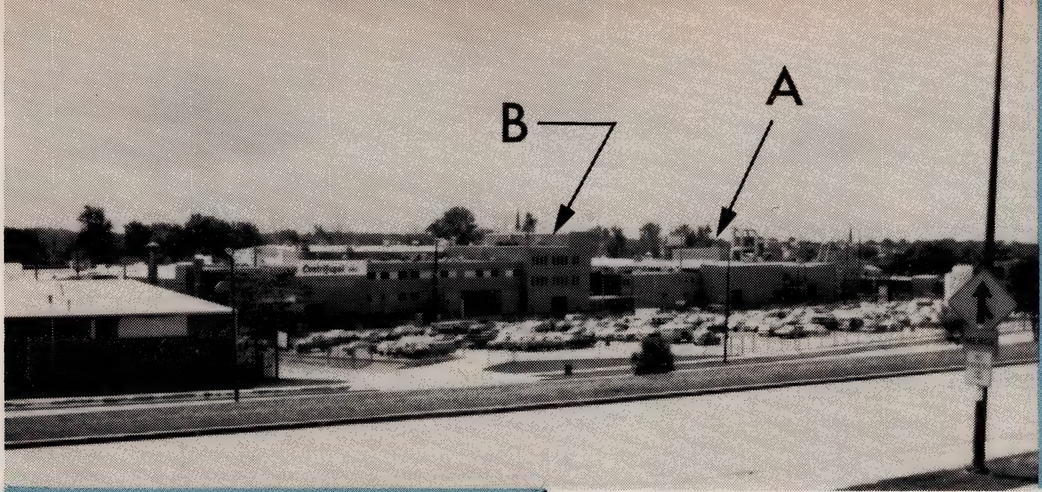


Fig. 2 Wisconsin Centrifugal Inc. as seen from the bluff to the south. Point A indicates recommended site for wind generator.

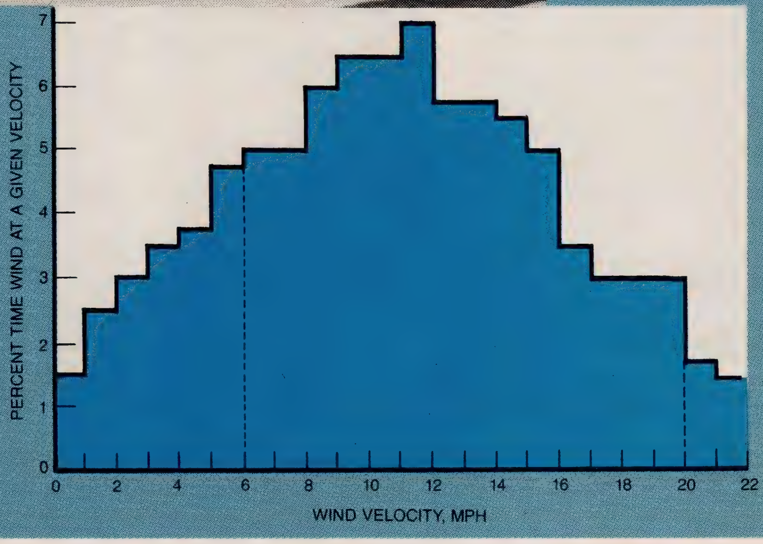


Fig. 3 Frequency of wind at various free stream velocities.

TABLE 1

Fork Truck Usage at Wisconsin Centrifugal, Inc.

Truck No.	Department	Usage (Hours/Week)[1]
16	Maintenance	15.6
43	Stainless	28.7
47	Maintenance	15.8
48	Cut-off	26.2
49	Bronze	38.9
50	Stainless	5.3
51	Die Shop	38.6
52	Fabrication	37.9
53	Machine shop	83.2
54	Cut-off	42.0
55	Shipping	24.2
56	Fabrication	63.2
57	Smelting	42.7
58	Smelting	57.3
59	Machine shop	50.5
60	Die shop	10.9
61	Receiving	40.2
63	Smelting	8.7
64	Stainless	21.9
65	Stainless	6.6
66	Stainless	12.3
67	Stainless	68.8
68	Stainless	10.3
69	Maintenance	16.1
70	Die shop	37.0
71	Heat treat	72.8
72	Bronze	64.3
73	Shipping	Broken hour meter
74	Stainless	52.6
75	Maintenance	Broken hour meter
76	Maintenance	5.1

[1]These averages are the results of a weekly survey of fork truck usage for one month. The averages were corrected for any loss time caused by equipment maintenance or repair.

and smoke from the furnaces, are favored over propane.

Framework for Economic Analysis

The decision of whether to invest in a capital asset is made based on the determination of whether that investment generates sufficient revenues to cover all costs, including the cost of capital. The determination of whether this is the case is typically made using one of the discounted cash flow models. The discounted cash flow models relate the amount of capital invested in an asset and the cash flows generated by that asset to a minimum return criterion. (For a more detailed discussion on the basic techniques of investment analysis, see DaGarmo et al. [5].) The specific form of discounted cash flow model used here is the present value approach, where all cash flows are converted to their present value equivalent using the cost of capital for the firm as the discount rate. Costs and revenues are then compared on a present value basis.

The specific investment decision being evaluated here is which type of forklift truck—electric or propane—should be purchased by the firm. Because these lift trucks are not tied directly to any specific product, but rather are part of the overhead for the firm, the decision will be made between the two alternatives based on which minimizes cost rather than which maximizes return on investment. Minimizing costs is consistent with maximizing return. Thus, the decision will be to invest in the truck which has the least present value of cost.

The decision between the propane and electric powered forklift trucks has two unique features that require

specific adjustments to the process of measuring the present value of cost. The first feature needing attention is the fact that the two types of trucks have different lives. The propane truck has a life of 6 yr and the electric a life of 8 yr. This introduces a bias in the present value analysis [5]. The normal approach to eliminating this bias is to assume that each alternative will be evaluated as an initial investment and a series of replacements. The replacements continue until both assets expire at the same point in time. For these two trucks, that point will be in 24 yr. Therefore, the cost of a series of four propane trucks will be compared to the cost of three electric trucks.

The second unique dimension of the decision is that there are two sources of electric power to recharge the electric truck batteries—purchased power or wind-generated power. The firm will, of course, use the source that is least costly. Based on current costs, purchased power is the least expensive, but because of the prospect of inflated energy costs, the two costs must be compared with each other for each year within the 24-hr horizon. The appropriate energy cost stream for the electric truck depends on whether the company switches from purchased power to wind-generated power. The determination of this is a prerequisite to measuring the present value of cost associated with the electric truck.

Wisconsin Centrifugal's Economic Analysis. The economic analysis of which truck will minimize cost for Wisconsin Centrifugal basically involves the identification of the amount and timing of the various costs associated with each alternative. The basic economic data are given in Table 2.

The first step is to determine if and when the wind-generated power becomes the least costly source of electric power. In order to make costs comparable, the cost of the wind generator was converted to an annual equivalent figure. To do this, the net investment in the generator—purchase price minus investment tax credit—was converted to an annual capital amount using the 10-percent environment cost of capital. (In addition to regular 10-percent investment tax credit, the firm can take an additional 10 percent for energy-saving investments.)

The \$2700 (1-0.80) allocated over 10 yr at 10 percent is the equivalent of a \$352/yr cost. Added to this is the after-tax cost of maintenance, \$14—\$27 × (1 − 0.48), and the tax effect of depreciation, \$130—(\$2700/10) × 0.48), is subtracted. The net annual cost for the wind generator is \$236.

The purchased power costs that would be eliminated by using a wind generator would be the marginal cost of purchasing power on an annual basis. Based upon the 16-hr truck use per week, the Wisconsin Electric cost structure, and charger efficiency, the current marginal power cost is \$49.74/yr. To be conservative in the estimates, the demand charge was not considered as part of the marginal cost of purchased power, even though

TABLE 2

Truck-Related Costs		Cost	Life
Propane:	Truck	\$18,810	6 yr
	Maintenance	\$0.73/hr usage	
Electric:	Truck	\$21,680	8 yr
	Battery	\$7000	6 yr
	Charger	\$1460	15 yr
	Wind generator	\$2700	10 yr
	Maintenance (truck)	\$0.40/hr usage	
	Maintenance (wind generator)	\$27/yr	
Energy-Related Costs			
Propane:		\$0.494 gal	
Electric:			
General primary time of use CP-1 rate			
	Customer charge	\$645/mo	
	Demand charge	\$3.96/kW (July–October)	
		\$2.87/kW (November–June)	
	(If energy not used during peak hours—no charge)		
	Energy charge:	Peak 2.8¢/kWh	
		Off-peak 1.4¢/kWh	
	Peak Hours—Monday–Friday 8 a.m.–8 p.m. excluding holidays		
	Demand —highest measured use in a 15-min period during peak hours.		
Company-Related Costs			
	Cost of capital (regular investments)	15%	
	Cost of capital (environmental investments)	10%	
	Tax rate	48%	
	Depreciation	Straight line	

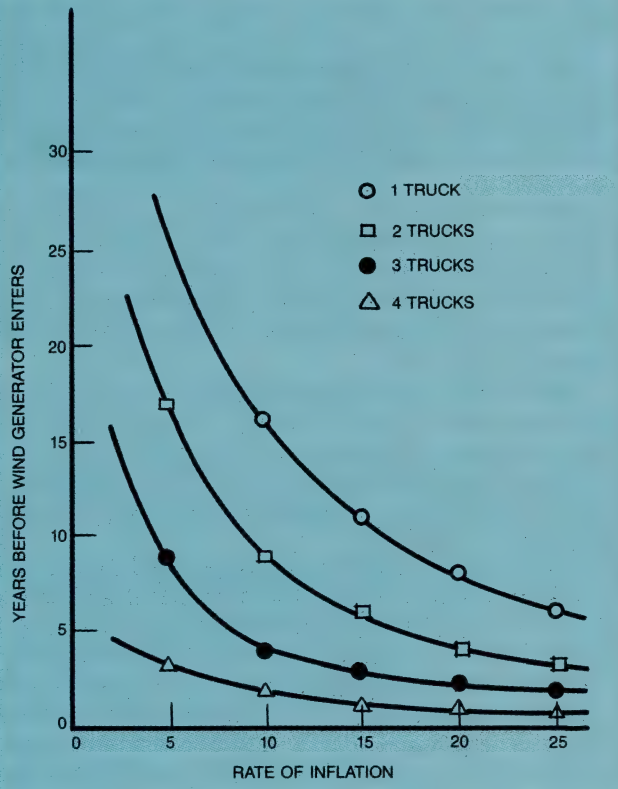


Fig. 4 Time when wind-generated power replaces purchased power.

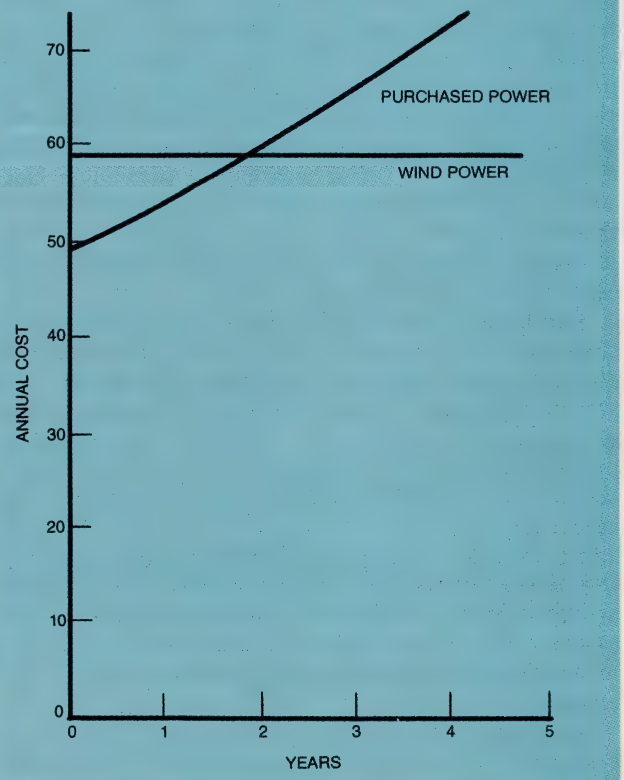


Fig. 5 Energy cost curve for four truck service level.

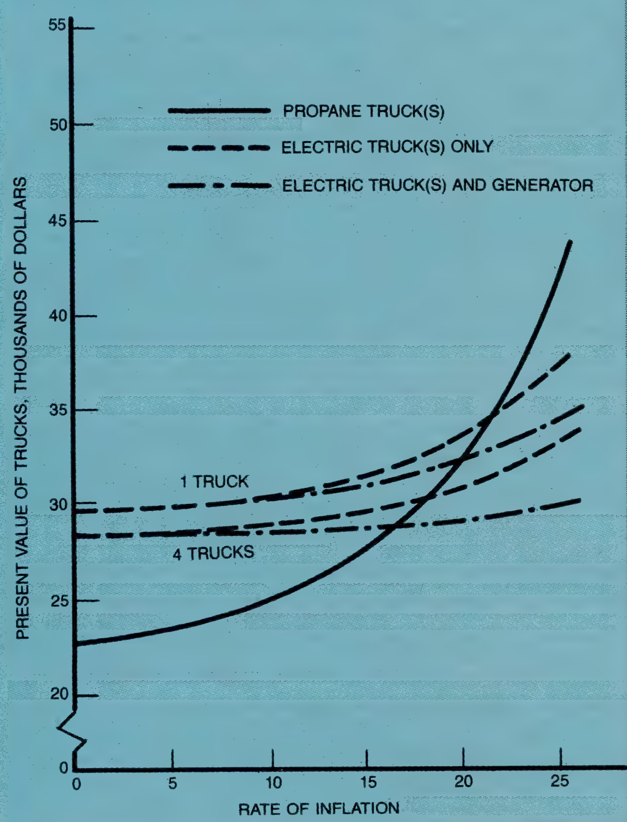


Fig. 6 Present value costs versus rate of inflation for energy.

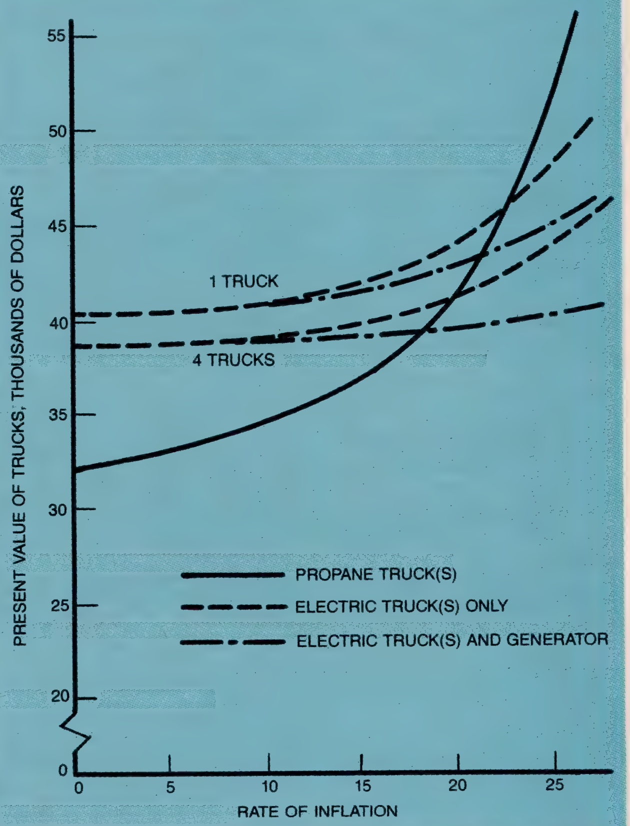


Fig. 7 Present value costs versus rate of inflation of all costs.

it is not expected that the demand charge would be incurred when using a wind generator. (The demand charge is based upon the highest amount of power demanded at any point within a month regardless of how long it is demanded. With the wind characteristics at Wisconsin Centrifugal it is expected that 100 percent of power can be supplied by wind, but if at any time purchased power is used, the charge is effective.)

Figure 4 shows the number of years before the wind generator enters into the decision, considering various rates of inflation for up to four trucks. Four trucks in the maintenance department have a use of about 16 hr/wk and could receive their required charging from the capacity of this generator. For example, at a 10-percent rate of inflation, and servicing four trucks, the wind-generated power becomes less expensive than purchased power in two years. At that point the cost of purchased power is $\$49.74\ (1.10)^2 = \$60.19$ while the cost of wind power is $\$236/4 = \$59$. The economic analysis assumes that there will be no increase in cost in a wind generator. The basis for this assumption lies in the observation that the price of wind generators has decreased over time. It is expected that increases in cost of material and labor will be offset by productivity gains as the volume of generator production increases. (Even if this assumption turned out to be incorrect, the cost of wind power would be constant for minimum periods of 10 yr, the life of the generator, once the generator was purchased.) Propane and purchased electricity, on the other hand, will undoubtedly continue to increase in cost in the future as they have in the past.

The availability of this energy alternative results in a cost curve that is the lower of the two cost curves for wind-generated versus purchased power. Figure 5 shows the net result for the 10-percent rate of inflation, four-truck example previously mentioned. Between Year 0 and Year 2 the purchased power cost function is used, and after Year 2 the wind generator cost function is used.

The next step in the analysis is to make the cost comparisons between the propane truck and the electric truck. Comparisons will be made with the five aforementioned rates of inflation on purchased energy and at service levels of one and four trucks. Economies of scale are realized for the electric trucks due to the productivity of the charger and the wind generator. No similar economies of scale are available to the propane truck.

Figure 6 shows the cost comparisons assuming no inflation in the cost of trucks, chargers, batteries, or maintenance, while Fig. 7 shows the comparisons assuming 10-percent inflation for 5 yr and 5-percent inflation for the remaining period for the aforementioned items. Because the pattern of investment is similar for both alternatives, inflation in these items does not significantly alter the decision.

The figures clearly show that the crucial element in the decision between propane and electric trucks is the rate of inflation in the cost of power. At low levels of inflation the propane alternative is less costly. But as the rate of inflation increases, the cost of the propane increases at a faster rate than that of the electric alternative, regardless of whether the electricity is purchased or generated. This result occurs simply because the cost of fuel is a larger component of total cost for propane trucks than for electric trucks. Even if the rate of inflation is the same for both sources of energy, the absolute increase for propane is greater because of the larger base cost. For instance, at a zero inflation rate the annual cost of energy for propane is \$256/yr versus \$107/yr for purchased electric power. A 20-percent increase in energy costs results in a \$26 increase for propane versus an \$11 increase for electricity. The key question is what the rate of inflation in propane will be versus electric energy costs.

It is an interesting fact that while the availability of wind-generated power doesn't significantly change the crossover point for propane and electric, it reduces the range of uncertainty in total electric costs. The cost of wind-generated power is primarily a capital investment type of cost. This cost is incurred when the wind generator is purchased. Amortizing this capital cost over the life of the generator results in a constant cost regardless of the rate of inflation. This reduces the range of uncertainty in total electric costs and thus total truck costs. The flatness of the total cost curve for electric trucks with wind generators versus the rate of inflation points out this fact. For instance the present value for one electric truck using purchased power ranges from \$29,689 to \$37,578, a range of \$7,889, while the prices and ranges are \$29,689 to \$34,573 and \$4884, respectively, when using the wind power option. This is a 62-percent reduction in the range of uncertainty. For one propane truck the prices and ranges are \$22,787 to \$41,602, a range of \$18,815.

Summary

Several conclusions can be drawn from the study. The on-site studies at Wisconsin Centrifugal Inc. indicate that the wind is sufficient to provide enough energy for recharging approximately one battery per day. Obviously, truck use patterns would determine the practicability of installation of a wind system. Once an acceptable pattern has been found, wind power becomes a viable alternative at moderate rates of inflation. Possibly more important is its attractive characteristic of reducing uncertainty in costs due to its lower variability with respect to inflation.

In general, there are probably many specific situations that possess, as does this application, the characteristics where wind power can influence and enter into an economic decision matrix.

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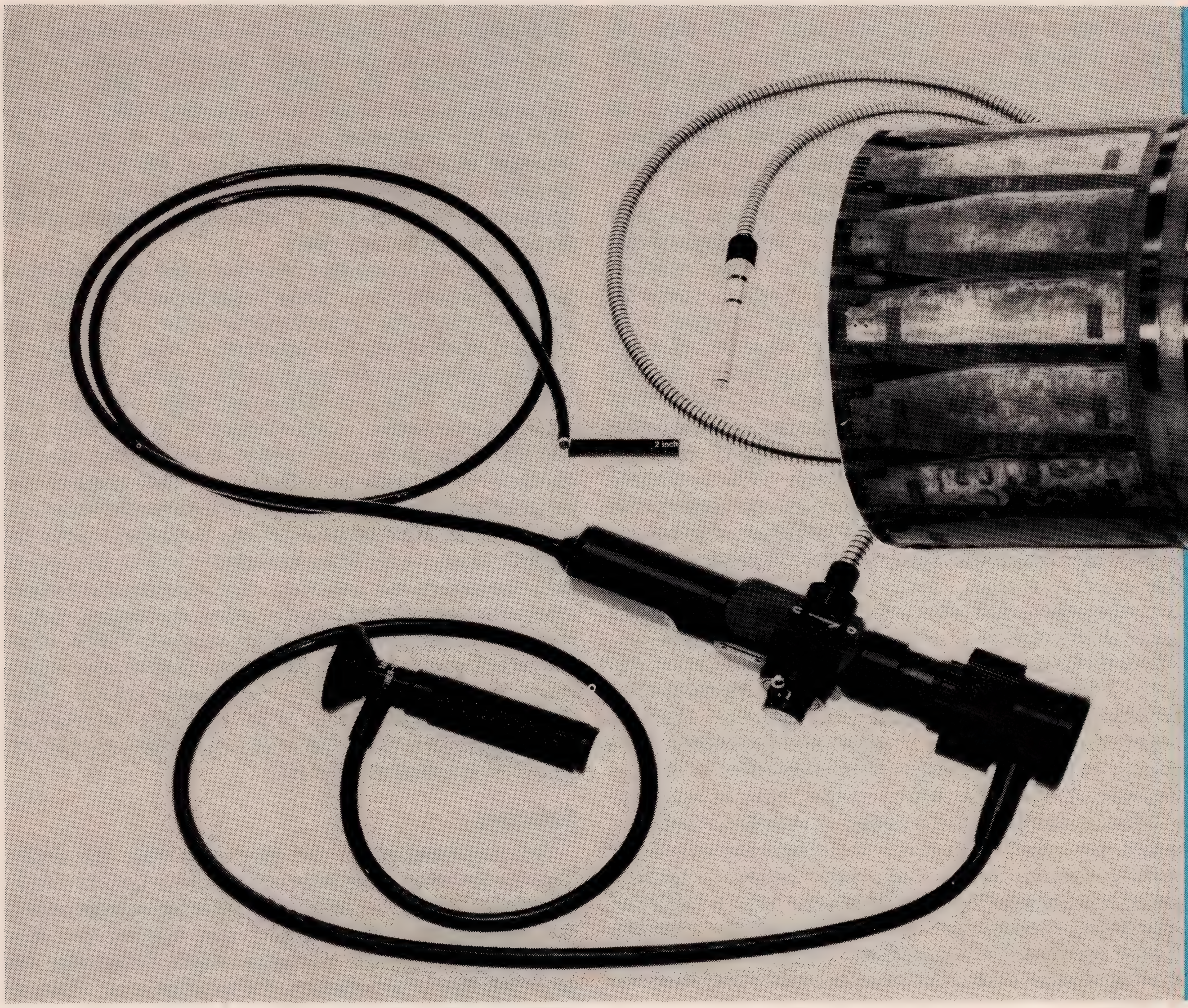

With the advent of U.S. military aviation's change from the fixed-cycle inspection concept to the on-condition maintenance (OCM) concept, it has become readily apparent to the aircraft maintenance people that their existing inspection methods and diagnostic tools are not adequate to keep pace with the new concept. Some of those components that required removal and disassembly to facilitate inspection should now be inspected on-the-wing to maintain the inspection flow time. Some means of gaining visual access to those components is required. A method has been developed to inspect the gas path of a turbine engine with sufficient accuracy to provide the user with the decisive information on whether to continue the engine in service or remove it for repair.

The original method of inspecting internal components of aircraft engines without engine disassembly, according to all available historical data, was with the use of a rigid borescope. This was simply a hollow, stainless-steel tube with a mirror encased in a fixture which screwed into one end of the tube and a flashlight bulb mounted into a window in the side of the tube. The light was powered by a 9-V battery and was connected by two fine copper wires up through the scope shaft. The eyepiece was a 10× lens aligned with the prism at the other end. It was a crude inspection tool but a significant advancement in engine inspection methods.

Simple as the borescope was, though, it had its faults. The bulb and mirror assembly were flimsy and would fall off inside an engine, forcing engine teardown—but never inside a reject engine, it seemed! And when the jet engine became the primary power plant for military aircraft, damage assessment became much more difficult. The close tolerances between the compressor rotors and stators made it impossible to see much more than three stages aft, much less determine the extent

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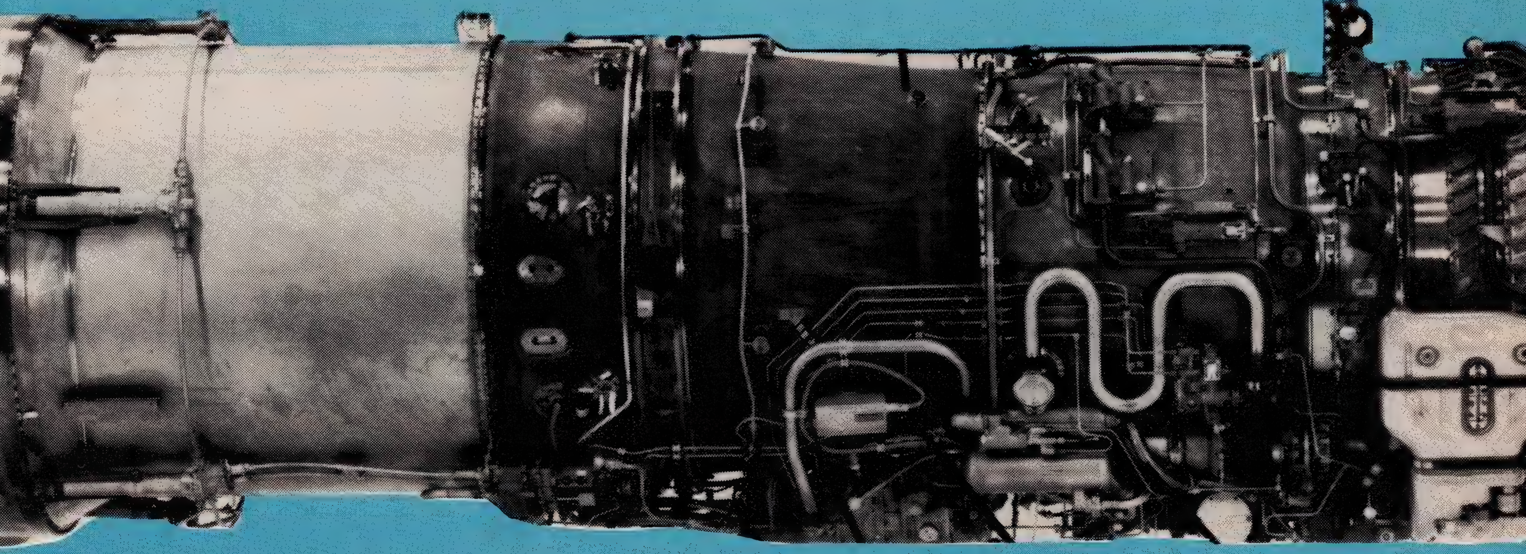

Fiber Optic Probes Monitor Engine Condition

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of the damage. Some method of access to the shorter compressor stages was required.

In 1958, the J75 (JT4) engine, which powers the F105 and F106 aircraft, was designed with borescope access ports in the outer compressor case, which facilitated penetration into the third, seventh, and ninth stages of the compressor. At the same time, the Air Force sought assistance from medical equipment vendors for a more suitable inspection instrument. The first one-piece units procured were far superior to the earlier models, but they still caused problems due to the bulb unscrewing from the tip or electrical system failure. There were occasions, however, when ninth-stage compressor health condition could be detected—a significant advancement in maintenance engineering when compared to the old procedure of spending 200 man-hr to disassemble the engine and inspect the compressor.

Probably the most significant advancement in jet engine nondestructive inspection methods occurred when the F100 engine was designed with borescope access ports in the combustor and turbine area in addition to four ports in the compressor, Figs. 1 and 2. This opened a whole new world to the maintenance man in determining "hot section" health condition. With this new capability, if the engine had high temperature, stalls, vibration, thrust loss, or other indications of gas path degradation, he could now inspect the combustor and rotors simply by inserting the borescope into the turbine area, rotating the surfaces in front of the scope.

One major problem still remained in determining the true condition of the gas path. Approximately 70 percent of the typical turbine engine gas path is nonrotating but still vulnerable, in varying degrees, to all of the conditions that degrade engine performance. Hence, some method was required to inspect these static surfaces.

Once again, the medical supply companies were approached to determine if those same flexible examining tools used by the physician on the human body could be used by the maintenance technician to penetrate a jet engine. This writer's first association with a fiber optic borescope was in 1973 while trying to determine the status of the first-stage turbine vanes on a B52 engine. It appeared phenomenal to the troops on the flightline to be able to see inside a jet engine in 20 min, when it normally required about 120 man-hr. This same feeling of surprise is displayed even today every

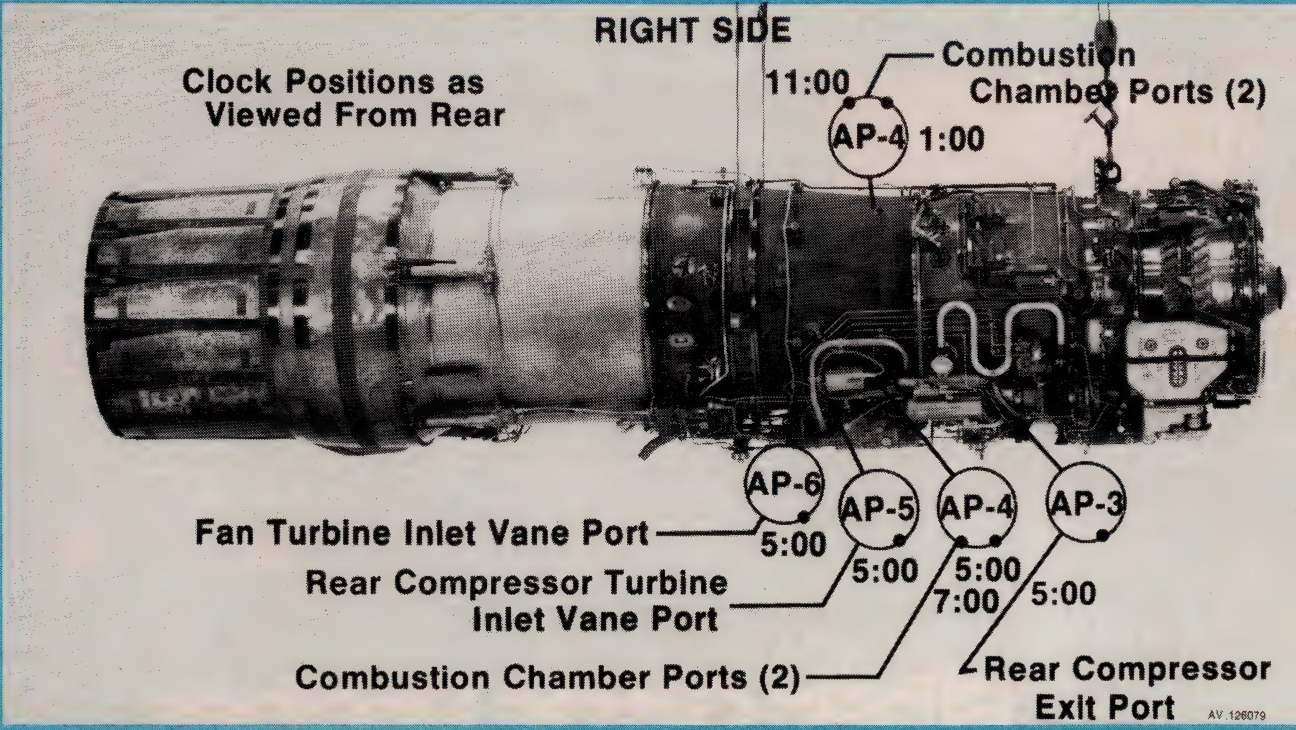

Fig. 1 F100 borescope port locations (right side).

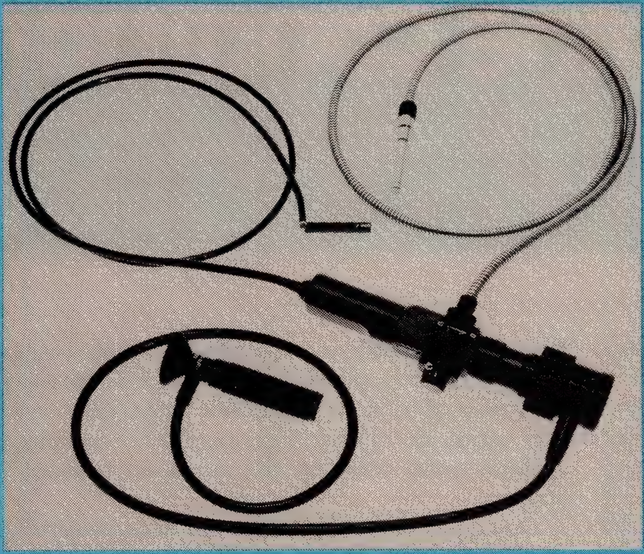

Fig. 3 Fiberscope with teaching scope attached.

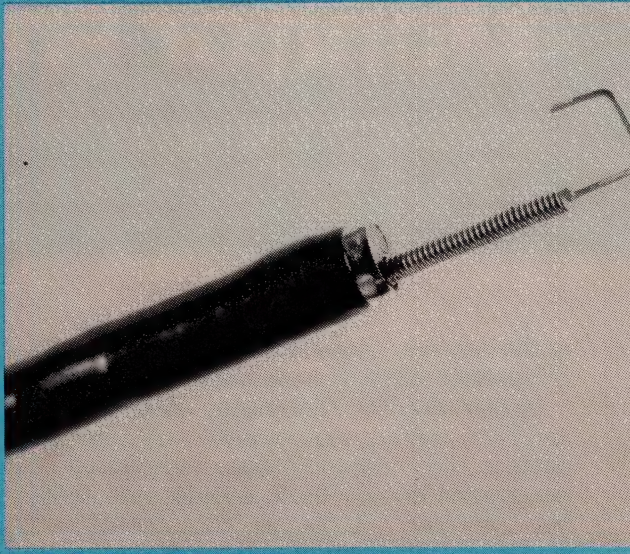

Fig. 4 Remotely controlled aluminum hook.

time the fiberscope's (from "fiber optic borescope") capabilities are demonstrated, regardless of the audience's technical level.

Expanded use of the fiberscope was slow, due to the fact that there were either insufficient access ports or none at all. In 1978, the ultimate challenge for the fiberscope arose when the F100 engine started experiencing second-stage turbine vane erosion. Off-the-shelf fiberscopes fell within two classes—either long enough but too big in diameter, or the right thickness but too short. Several fiberscope manufacturers were approached with little success. They either didn't want the technology challenge or their optics quality was unsatisfactory. A company was finally located that not only accepted the challenge but agreed to assist with the access and inspection problems. As an inspection team was required in the field immediately, the only access available at that time was through the third and fourth stages of the turbine. Engineers and technicians were trained to articulate the fiberscope through the turbine rotors and stators up to the second-stage vanes. This was accomplished by crawling up the augmentor and making 29 penetrations through the turbine in order to see all 58 second vane airfoils. This procedure took about 8 hr per engine and the scopes held up well, but the people did not. Another method of penetration was

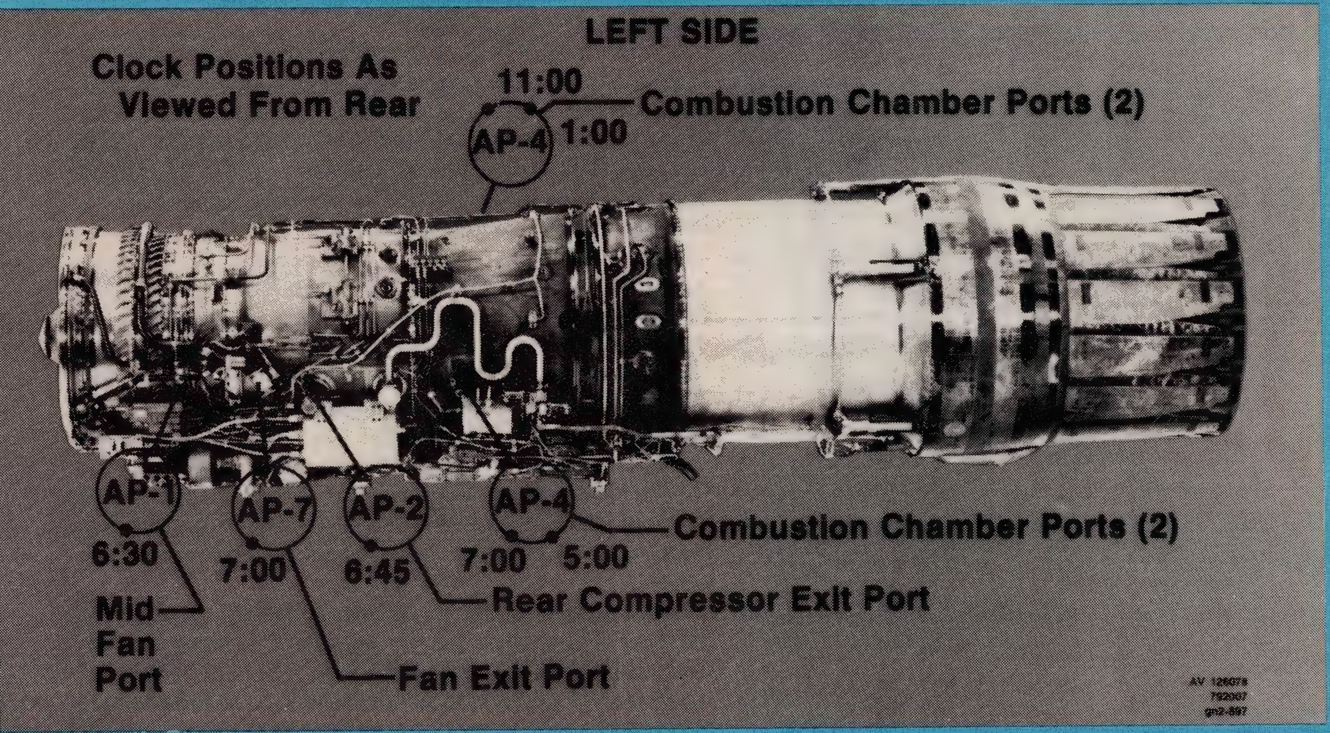

Fig. 2 F100 borescope port locations (left side).

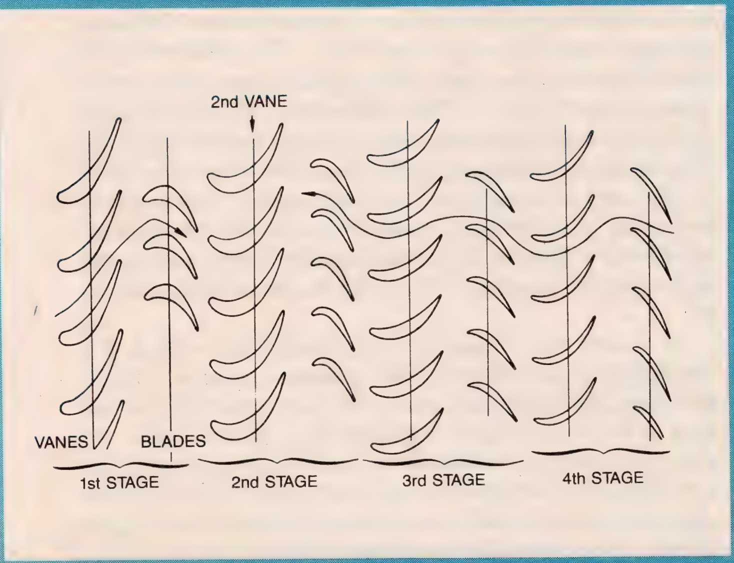

Fig. 5 Turbine blade and vane layout.

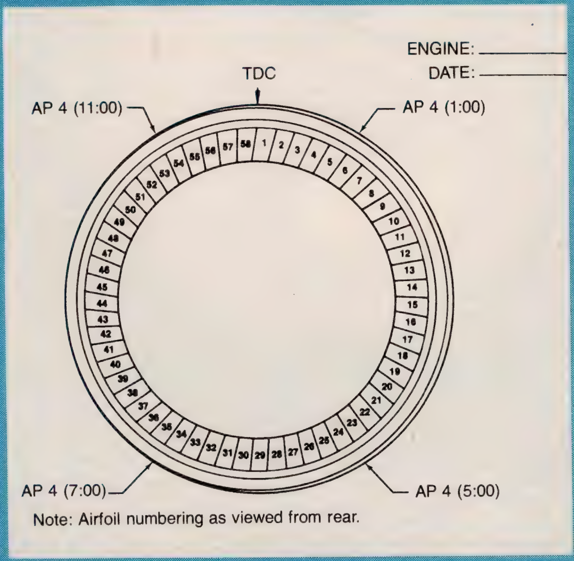

Fig. 6 Vane map and inspection sheet.

required and it was soon developed. This was to demonstrate the tremendous potential of the fiberscope.

The fiberscope developed at that time was similar to the typical bronchoscope, which is used primarily to examine the upper lobes of the human lung, Fig. 3. It is 6 mm in dia, but the length was redesigned from 60 cm to 150 cm to provide the required length for second turbine vane inspection. It has a 2.2-mm Teflon tunnel which runs the full length from the viewing head to the tip, and is used by the physician as a channel for tiny forceps to extract a biopsy of the suspect lung tissue. This tunnel was ideal for the maintenance technician for inserting 1.8-mm spiral cable until it protrudes out of the tip. Then a small aluminum (in case it breaks off, the engine won't be damaged) hook is screwed into the cable, Fig. 4, and a cable lock is attached to the opposite end at the viewing head. This remotely controlled hook allows the technician to insert the fiberscope into the combustor access port, maneuver the tip aft through the first-stage vanes and blades to the target area of the second stage vanes, Fig. 5. Once he has the second-stage vane in his viewing image, he extends the hook and attaches it to the trailing edge of the first-stage blade, which is barely visible in his image. Once attached, he locks the hook in place and an assistant rotates the turbine wheel by turning the power takeoff shaft at the

Fig. 7 Damaged turbine vane.

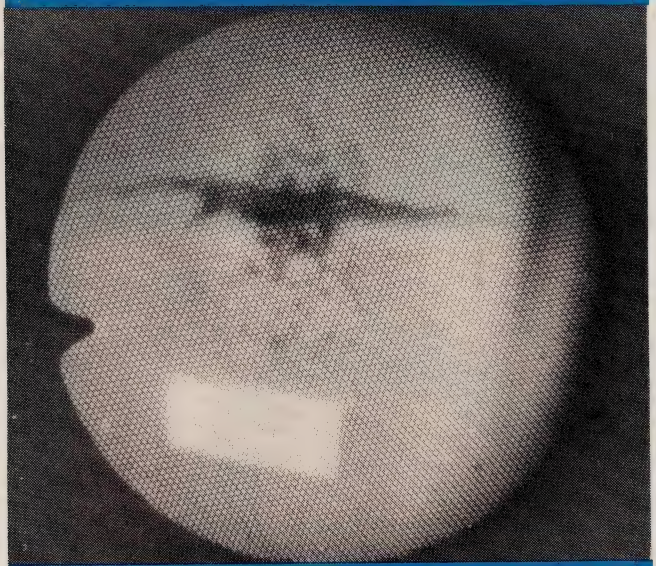

Fig. 8 Vane damage photographed with the fiberscope and a 100-mm lens.

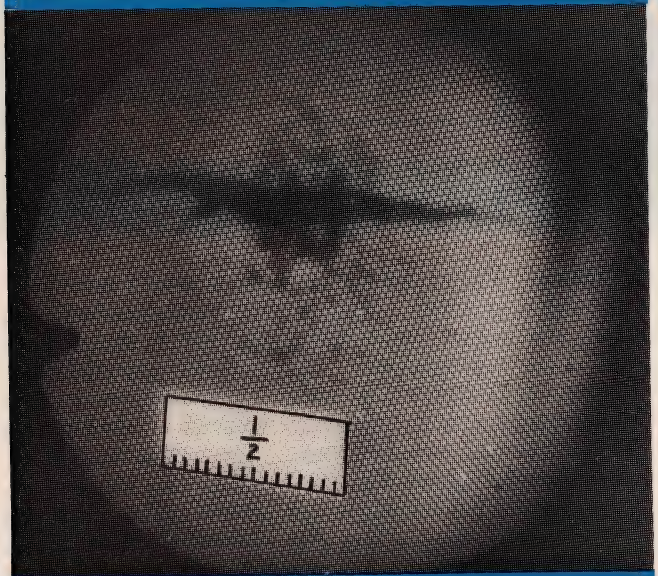

Fig. 9 Vane damage photographed with a 200-mm lens.

engine gearbox clockwise. This moves the viewing tip past the vanes and the engine actually swallows the entire fiberscope insertion tube.

A vane map, Fig. 6, is provided so that the inspector can record any damage noted on the airfoil when it is discovered. This vane map becomes a part of the engine record so when the next inspection is performed, the previous inspection results are used for reference. This procedure has been put to excellent use in tracking crack propagation and erosion.

The 150-cm fiberscope is long enough to facilitate inspection of 30 second-stage vane airfoils. As there are 58 airfoils in the second-stage vane area, a double penetration, 180 deg apart, is required. This can be done easily on the F15, as there are access panels to the top combustor access ports down through the top of the aircraft. However, on the F16, these top access panels are not available. To avoid rolling the engine back each time to perform the inspection, a 260-cm scope is now in development to provide single-insertion, 360-deg inspection capability. Initial tests indicate excellent potential.

Once access to the target areas was attained, some method of determining the extent of damage was required due to the damage limits applied to each area. Since the tip of the fiberscope is always locked in place and remains the same distance from each vane, photographing the damage is possible for further damage assessment. Figure 7 shows a damaged vane, indicating surface burning and cracking. Figure 8 shows the same damage shot with a 100-mm lens. To determine the exact length of the crack, the same damage photograph was enlarged, Fig. 9. The honeycomb effect is actually the individual glass fibers which comprise the objective bundle of the fiberscope, and since the fibers are exact in size and symmetrical in construction, this pattern serves as an excellent measuring tool for damage assessment. Simply by counting the fibers along the damage area, assessment can be made to within 0.020 in.

In every new discovery or application, there are negatives to accompany the positive aspects. In fiberscopy, the technician must learn and practice a whole new way of handling equipment. Fiberscopes are constructed from thousands of finely drawn glass fibers, and although they will transmit light and images around sharp angles, they will not withstand rough handling or abuse. A prerequisite to any new fiberscope inspection project is a strong training program with emphasis on care and handling disciplines.

Technological advancements using fiberscopes are constantly being made. Videotape recording and Polaroid photography are already available. Ultraviolet inspection methods are being developed to provide the maintenance technician the capability to determine a surface scratch from a crack. Numerous other programs such as fiber optic implants and scanners are under study, and when developed, they will provide the user with constant gas path health information. The tools will then be available for him to operate the engine until performance conditions indicate that some form of rehabilitation is necessary.

Based on a paper contributed by the ASME Gas Turbine Division.

The Rebirth of The Rankine Cycle

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The Energy Revolution, as characterized by the transition from exhaustible fossil fuels to the use of renewable fuels, offers new opportunities for the Rankine cycle. In fact, the Rankine cycle by itself, or in combination with other cycles in a system of cascading, can be readily coupled to a variety of low-temperature industrial waste streams and renewable energy sources to recover large amounts of energy. This represents an excellent example of energy productivity that is focused on producing more with the same energy supply, as opposed to doing with less or changing our life styles, which conservation seems to imply. The Rankine cycle has long since proven its technical capabilities and versatility. It now remains to be shown that, in its new role in waste heat recovery, it makes economic sense as well.

The energy that is currently being discharged as waste heat from industrial plants amounts to nearly 11 quads. Figure 1 illustrates the distribution of these industrial thermal discharges as a function of temperature [1].[3] The latest estimate of total energy consumption in the U.S. is in the neighborhood of 78 quads, with the industrial sector accounting for roughly 28 quads. Thus, industrial thermal wastes amount to approximately 14 percent of total U.S. energy consumption and about 36 percent of the industrial energy consumption. The industrial thermal wastes are clearly attractive targets for conversion into useful thermal, mechanical, or electric power because of the large volumes of heat involved and because of the relatively high temperatures at which it is available. Furthermore, additional thermal discharges are obtainable from the utility stations and from the federal uranium enrichment plants as shown in Fig. 2. While the temperature potential of these wastes is somewhat lower, it still amounts to over 14 quads of energy. Therefore, in the combined industrial, utility, and federal sectors, there are close to 25 quads of thermal wastes that can be profitably tapped with a temperature distribution as indicated in Fig. 3.

Energy Conversion

With the rapidly escalating cost of exhaustible energy resources, it is becoming increasingly important to find economical ways to reduce these thermal discharges and

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[3] Numbers in brackets designate References at end of article.

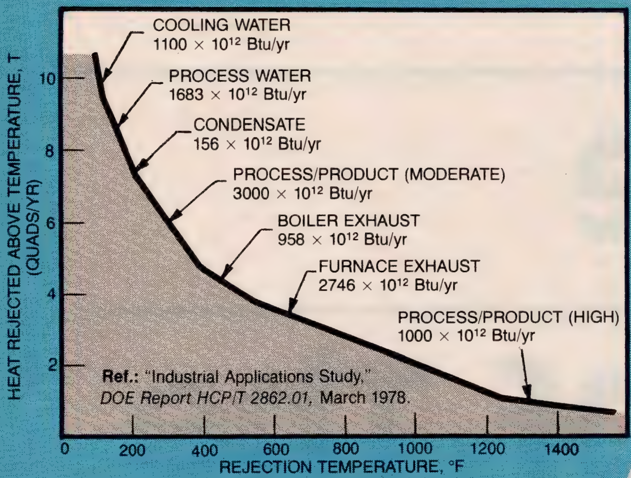
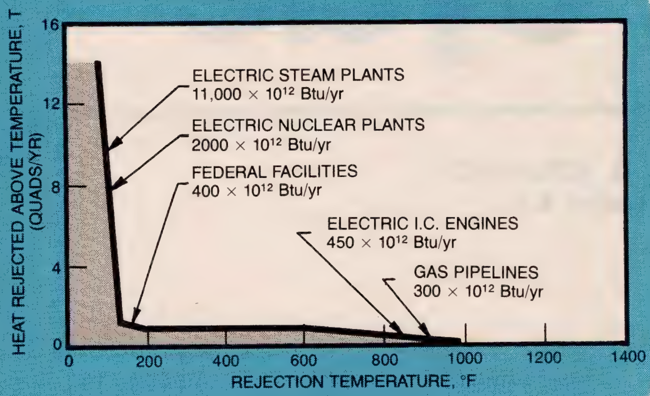


Fig. 1 Distribution of industrial waste heat flows [1 quad = 10^{15} Btu = 293 × 10^9 kWh; C = (F-32)/1.8].



Ref.: Energy Information Agency Annual Report.

Fig. 2 Distribution of utility and federal facility waste heat flows [1 quad = 10^{15} Btu = 293 × 10^9 kWh; C = (F-32)/1.8].

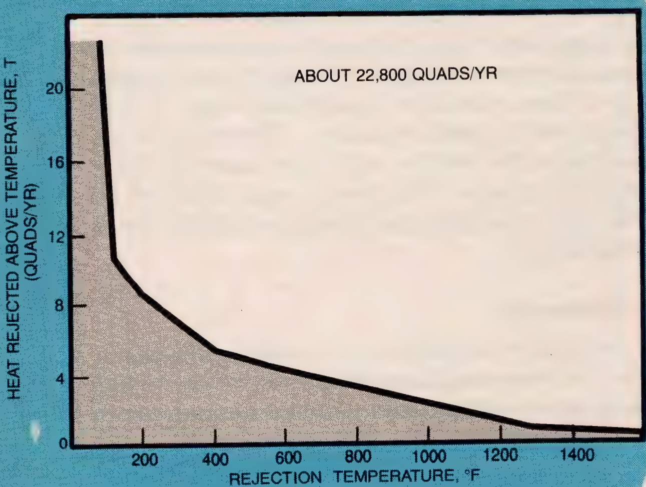


Fig. 3 Distribution of utility, industrial, and federal facility waste heat flows [1 quad = 10^{15} Btu = 293 × 10^9 kWh; C = (F-32)/1.8].

to utilize effectively those that remain. It is also imperative to find methods to harness efficiently such renewable thermal energy sources as solar, geothermal, and biomass. The authors have focused their attention on an analysis of the likely heat engines that can best be employed to convert to useful power all of these different thermal energy sources. Since many of the thermal streams offer only low levels of temperature, the ideal heat engine cycle should have a high efficiency within this given range of temperatures. Figure 4 presents the realizable efficiencies of some of the better-known heat cycles compared to the Carnot cycle. It can readily be seen that—particularly at the lower temperatures—the Rankine cycle has the highest realizable efficiency. This unique characteristic of the Rankine cycle provides it with its special capability for matching up to the low-level temperature waste streams.

The Rankine Cycle

We have found that the Rankine cycle is an effective energy conversion system in which a wide spectrum of waste streams at various levels of temperature serve as the energy input for the cycle. A large number of fluids can be used in a Rankine cycle in a broad range of applications—as illustrated in Fig. 5—using different heat sources. The main features of the Rankine cycle are listed in Fig. 6. In order to obtain the highest Rankine cycle efficiency at a specified temperature level, it is first necessary to choose an optimum Rankine cycle working fluid. At the low-temperature end, organic fluids (Fig. 7) are the most effective; while at the high-temperature end, liquid metals are probably the most suitable. MTI engineers have tended to rely primarily on steam and fluorcarbon refrigerants. Although almost any type of fluid [2] can be used in a Rankine cycle engine, each one obviously has certain advantages and disadvantages [3–5].

In the lower-temperature applications, considerable attention must be paid to the major heat transfer and conversion components. The low thermodynamic quality of the heat source requires large heat exchangers, which add to the cost of the systems. The aerodynamic and mechanical efficiencies of the conversion machinery must be high so that the maximum amount of power is realized at a reasonable cost. The cycle temperatures that result in a minimum equipment cost for Rankine systems are plotted in Fig. 8. It is especially interesting to note that the minimum cost Rankine cycle coincides with the present-day cost of a central station steam power plant.

Higher Efficiencies

There are two factors that cause the Rankine cycle to move away from the minimum cost point. In the case of higher temperatures, the motivating factor is to increase the utilization of the thermodynamic potential of the combustion temperatures of the fuel. However, these higher temperatures imply that liquid metals will be employed which, in turn, calls for expensive high-temperature materials in the system. Unfortunately, experience has shown that severe erosion and corrosion problems are frequently encountered with liquid metals. There are, however, several other cycles (e.g., Brayton,

Stirling) that are able to operate at the higher temperature ranges at higher efficiencies than the Rankine cycle can achieve by itself (Fig. 4). Combining any of these alternate high-temperature cycles with a low-temperature Rankine cycle in a cascaded system, Fig. 8, results in a higher combined-cycle efficiency.

In the case of lower temperatures, the key consideration is the use of "free" waste thermal discharges and those available from the renewable sources (i.e., solar, geothermal, biomass, etc.). The application of a low-temperature Rankine cycle brings with it low thermodynamic efficiencies and the need for large heat exchangers. But at the lower temperatures, there are no alternative cycles from which to choose. Therefore, in order to apply Rankine cycles effectively over a broad range of temperatures, a number of preconditions must be fulfilled. These are enumerated in Fig. 8. The qualitative cost behavior for Brayton, diesel, Otto, and Stirling cycles will be similar to the Rankine cycle, as displayed in Fig. 8. These cycles, though, are not applicable at low temperatures since they have a minimum practical operating temperature. Moreover, as the cycle temperature is raised to improve efficiency, exotic and expensive materials have to be incorporated in the equipment design and this leads directly to corresponding increases in the cost per unit output.

For any given state of development, there should be a minimum cost associated with the conversion machinery for a specified cycle. Figure 9 portrays the locus of minimum equipment costs as the cycle temperature varies. This plot indicates that there are heavy penalties in the cost per unit output as the cycle temperature drops. If the rationale for embracing low-temperature Rankine cycles is to make use of "free" thermal streams, then simple economics will dictate that the "free" sources that have the highest temperature potentials should be those that are exploited first. Figures 1–3 illustrate that there are many adequate sources of relatively high-temperature waste energy streams readily available.

Economic Considerations

The rapidly increasing cost of energy has increased the emphasis on life-cycle costing in industry's equipment purchasing policy. This change is especially noticeable in energy-intensive industries. Thus, waste heat recovery systems—even though higher in first cost (Fig. 9) than conventional steam turbines, gas turbines, or diesel generator sets—become practical on a life-cycle cost basis because their operating energy costs are zero. Nowadays, the total installed cost of coal-fired electrical utility plants with emission controls ranges between \$800 and \$1000/kW and the cost of nuclear plants is even higher—\$1200/kW and up. These costs are comparable to waste heat systems that use no fuel. Of at least equal importance is the fact that the waste heat recovery systems can be placed in operation in a fraction of the time required for central station power plants to go on stream.

The economic analyses for waste heat recovery systems are particularly sensitive to the following factors:

- Cost of energy in the specific industrial location
- Fuel escalation rate—percentage per year

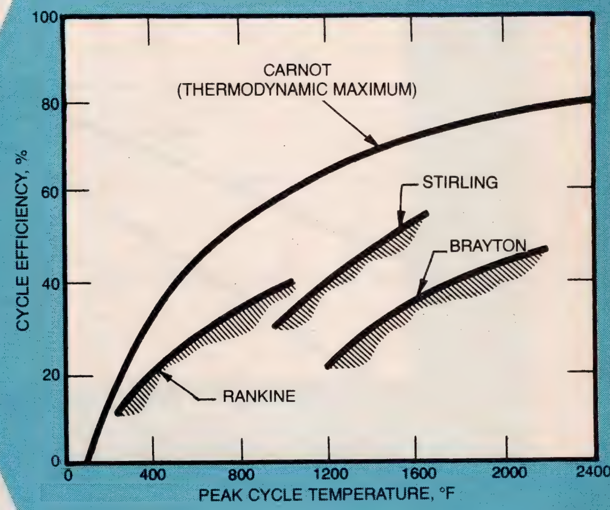


Fig. 4 Thermodynamic potential of engines [C = (F-32)/1.8].

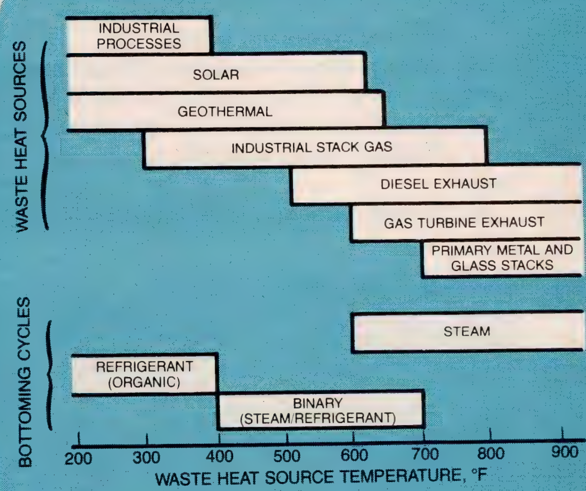


Fig. 5 Waste heat sources and MTI bottoming cycle systems [C = (F-32)/1.8].

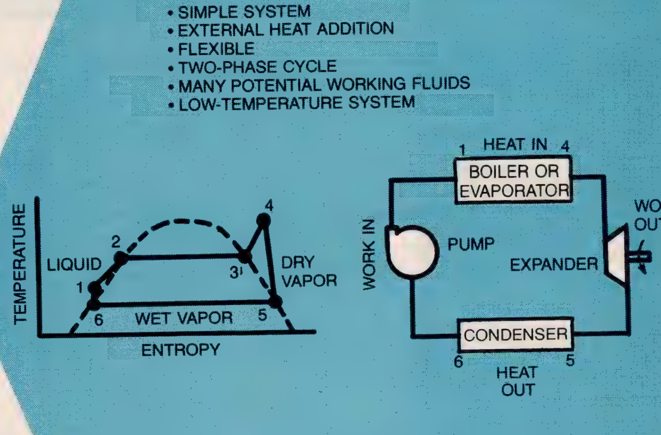


Fig. 6 Rankine cycle features.

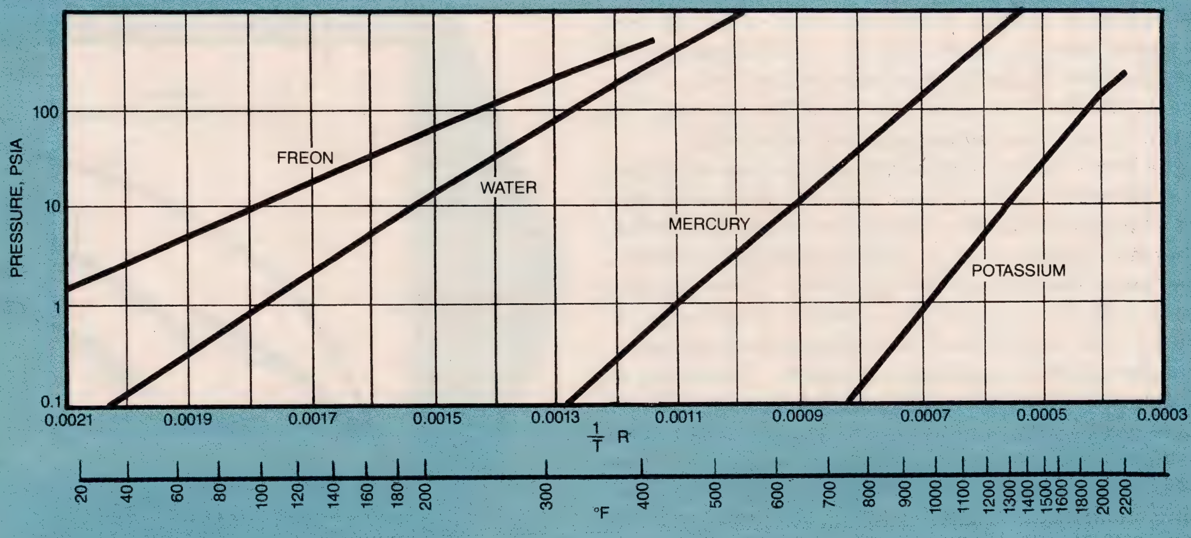


Fig. 7 Characteristics of selected Rankine cycle working fluids [1 psia = 6.89 kPa; C = (F-32)/1.8].

• Investment life for the equipment, process, or plant

• Yearly operating hours

• Availability of equipment (time between overhaul, cost and time for maintenance, reliability, etc.)

• Investment tax credit and depreciation

• Type of waste stream (condensing vapor, liquid, gas)

• Source and sink temperatures

• Characteristics of the waste stream (corrosion, erosion, sulfur content, etc.)

• Rating of the equipment.

The Investment Decision

In order to evaluate an investment decision, a basic financial investment analysis must first be made. This analysis is characterized by names such as discount cash flow (DCF) or internal rate of return. The DCF interest

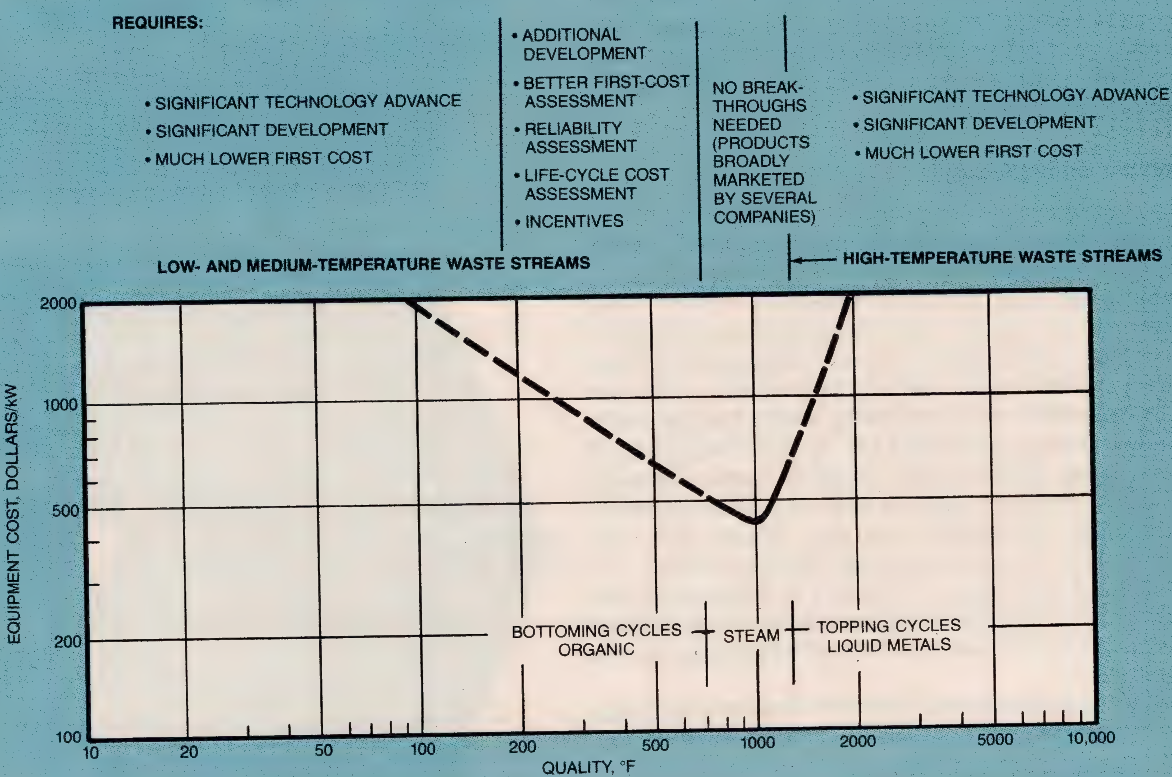


Fig. 8 Cost of Rankine cycle systems [C = (F-32)/1.8].

rate is a function of tax rates, energy costs, inflation, depreciation rates, investment tax credits, etc. Discretionary cost reduction investments that result from energy-saving equipment require a DCF in excess of 20 percent. The present high interest rates on money will certainly raise this number. While the current average industrial cost of electricity is approximately 3.0¢/kWh, it is clear from Fig. 10 that only in those regions of the country where this cost figure is above 4.5¢/kWh will energy conservation through waste heat recovery prove to be an economical proposition. If, however, industry were to use the marginal cost of electricity in its analyses, the economic justification for Rankine bottoming cycles would be greatly enhanced. Another parameter that has a significant effect on economic acceptability is the number of annual hours of operation, Fig. 11. Waste heat recovery equipment has the largest payoff when used in base load (continuous) operations.

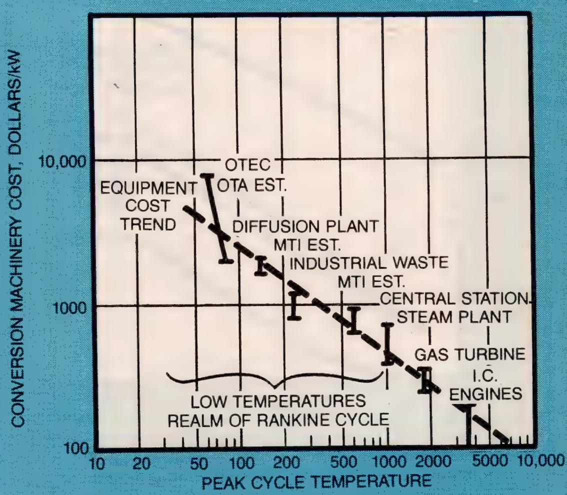


Fig. 9 Minimum equipment cost variations as a function of peak cycle temperature [C = (F-32)/1.8].

Financial Incentives

Legislation has already been enacted to increase the investment tax credit for certain types of energy conservation equipment. An increase of 20 percent in the investment tax credit, for example, will raise the DCF by about 6 percent. This could move a marginal investment into the region of acceptable economics. And by reducing the depreciation period to five years or less, the economics of waste heat utilization technologies will also tend to show a healthy improvement. Rapid amortization should serve to stimulate reinvestment and the purchase of newer and more efficient systems. This measure, which has a recent precedent in pollution control equipment, is good both from the standpoint of energy conservation and a strong national economy.

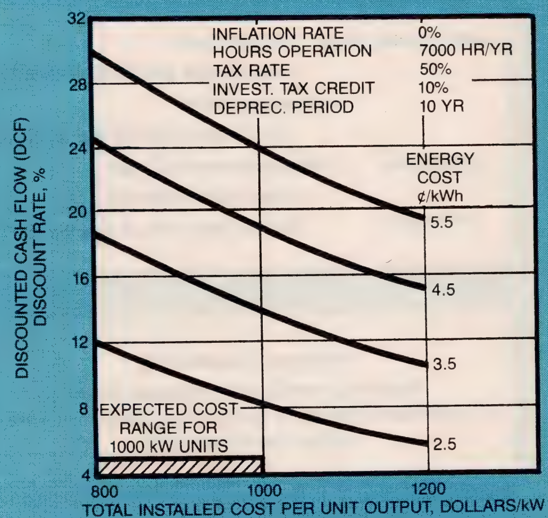


Fig. 10 Effect of energy cost on the discounted cash flow (DFC).

Figure 10 shows the effect of the cost of electricity on the DCF. The same conclusions apply as well to other forms of energy, such as gas and oil. Unquestionably, marginal or replacement pricing policies can have an enormous impact on conservation practices. Figure 12 presents owner economics as a function of energy cost in the case of three different forms of incentives. A direct subsidy equal to 25 percent of installed cost and the impact of an energy rebate based on $15/bbl of oil equivalent during the first year (assuming electricity is generated at 31 percent cycle efficiency) have approximately the same resulting DCF. One very powerful method for generating a strong market pull for new high-efficiency equipment would be to eliminate energy cost as a tax deduction. This means that the cost of energy will effectively double for industry, and the savings will double. The economic impact would be extreme, since most basic products are the most energy-intensive. The inflation impact would be amplified as the costs passed through the economy with margin markups. Such an action would have to be carefully considered. The consequences of such a move on a Rankine cycle investment are also projected in Fig. 12. All in all, the various incentives can provide a favorable climate for industry to invest in waste heat recovery systems. It is the perceived risk that is associated with equipment reliability, safety, and availability that is probably by far the most serious restraint to the broad industrial acceptance of the Rankine cycle waste heat recovery installations.

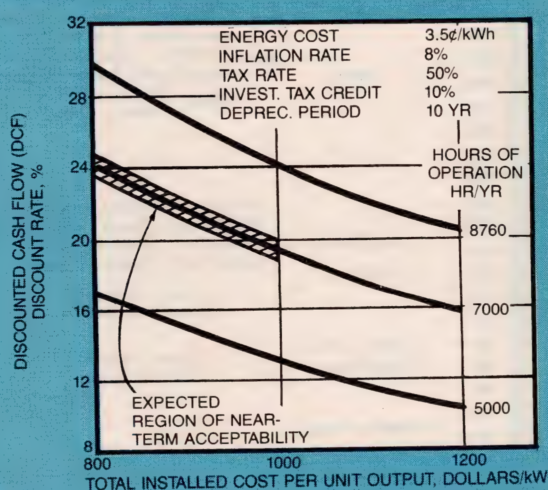
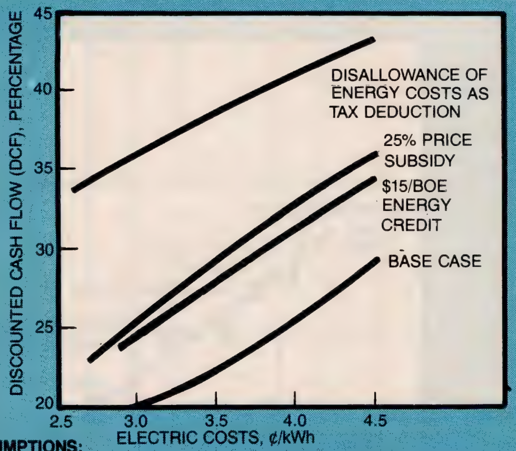


Fig. 11 Effect of annual operating hours on the discounted cash flow (DCF).



ASSUMPTIONS:
15-yr project life
8000 hr annual operation
Base system cost @ $ 1100/kW
20% investment tax credit
12-yr SOYD depreciation method
50% combined marginal tax rate
$30,000 O & M charge
3% local taxes and insurance

Fig. 12 Sensitivities of owner economics to various incentives for a Rankine bottoming cycle.

Life Cycle Cost = **First Cost**
(equipment and installation)
\+ **Energy Cost**
for the total life of the system
Efficiency + **Maintenance Cost**
(labor and material)
Reliability for the total life of the system

Fig. 13 Life-cycle costing concept.

Energy Cascading
Matching the Quality (Temperature) of Available Energy to the Needs (Requirements) of the Task (end use)

Fig. 14 Definition of energy cascading.

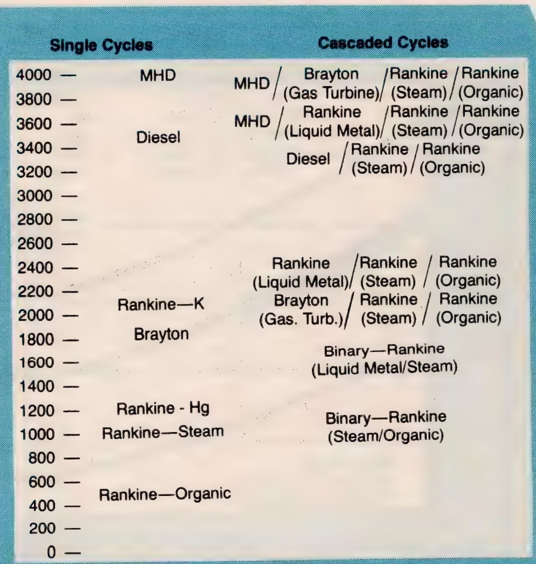


Fig. 15 Illustrations of energy cascading [C = (F-32)/1.8].

Public Acceptance Trends

There are several trends, however, that are slowly receiving public acceptance. When energy costs were low, the purchasing practice was governed almost entirely by first-cost criteria. Today, the philosophy of life-cycle cost, as defined in Fig. 13, is gradually gaining support. Government agencies, including the Department of Defense, and large energy-intensive industries have been leaders in changing purchasing practice to life-cycle cost. This approach places a higher value on efficiency and equipment reliability and accepts a first-cost premium provided that there is sufficient economic justification based on future payback.

As energy costs continue to rise, the principles of energy cascading [6]—as defined in Fig. 14—are receiving more critical attention. The concept of energy cascading encourages the use of combined cycles in order to increase overall system efficiency and to make more effective use of the quality of the energy source. Thus, the waste energy from one cycle furnishes the energy input to the next, and so on. This is vividly illustrated in Fig. 15. These combined cycles are inherently more complex and the question of their reliability will play a key role in determining their successful commercialization. On the other hand, combined cycles are much more efficient. Ultimately, it is the life-cycle costs that will govern the future acceptance of combined-cycle systems by industry. Energy productivity means that the waste thermal streams in each industry need to be carefully matched up with the respective specific energy needs (thermal and shaft power). Figure 16 schematically traces the energy flows and the type of information that is required for a cost-effective energy productivity program for each process and for every major industrial energy user.

Conclusion

The use of Rankine cycles with low-grade thermal sources offers significant potential for energy productivity, but is economically justified only with sources above a clearly defined temperature. The obvious policy would be to place the major emphasis on utilizing the highest thermal sources first since they are economical today. Industrial thermal waste sources are in the category of economic sources. The technological state of the art for the use of Rankine cycles with industrial thermal waste streams is at or near commercial availability. However, the lack of actual industrial experience with these systems has prevented the development of a real market.

Government actions are needed to accelerate the development and industrialization of the Rankine cycle technology. These actions must include not only the traditional R&D funding support but also incentives to buyers and sellers to overcome the initial market introduction problems. In the area of industrial thermal waste utilization, meaningful and varied demonstrations in actual industrial installations must be supported to eliminate the perceived risks that stand as a major market barrier. Moreover, additional investment incentives must be used to achieve rapid introduction of more efficient end-use technologies and processes to offset the imbalances caused by regulatory policy.

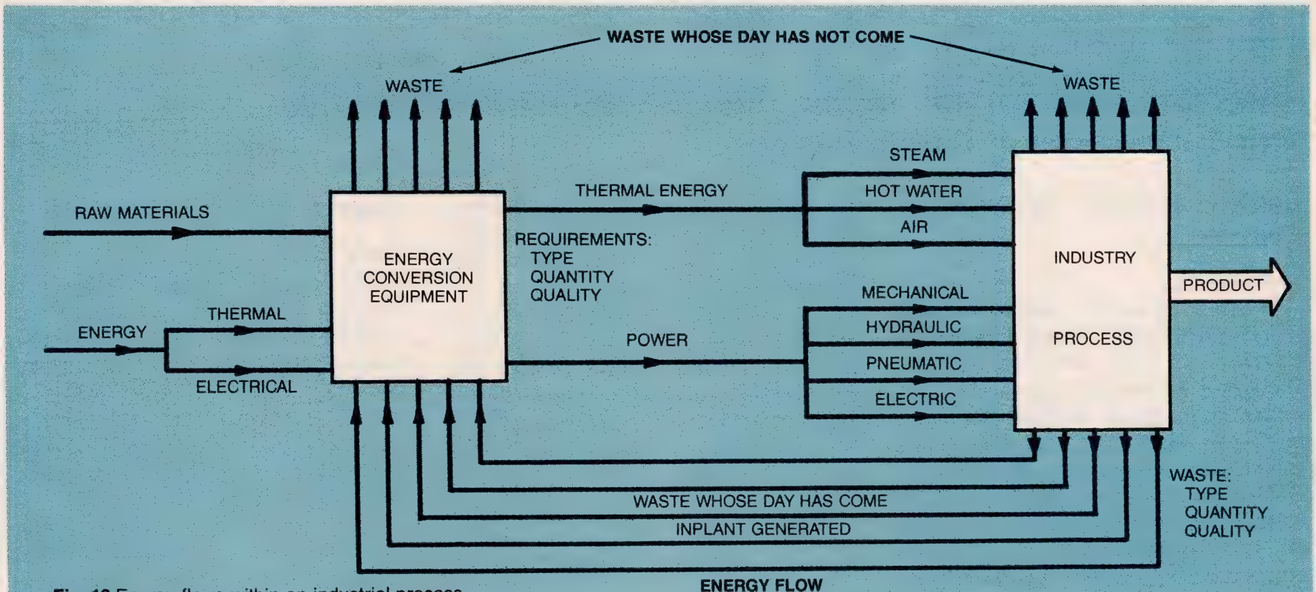


Fig. 16 Energy flows within an industrial process.

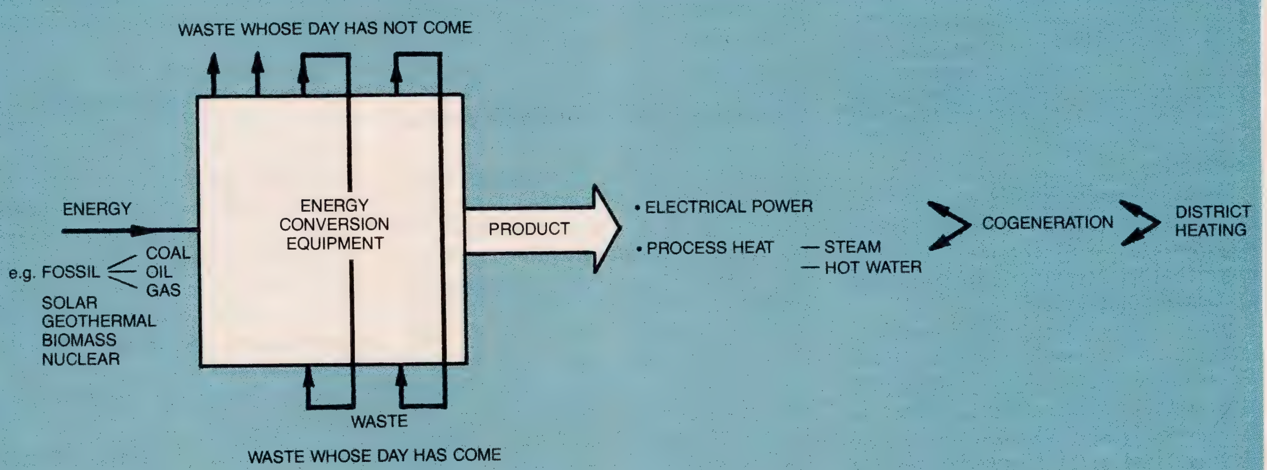


Fig. 17 Energy flows within an electric generation process.

In the past, cheap energy and planned equipment obsolescence encouraged the manufacturer to produce low first-cost equipment which was also low in efficiency. Major improvements in efficiency are possible. Government policy regarding incentives/regulations, removal of institutional barriers, life-cycle cost purchasing and pricing using marginal cost must be instituted to accelerate the introduction of new high-efficiency products. An attempt must also be made to replace obsolete equipment, thereby conserving great amounts of energy.

The new perspective on Rankine cycles is that they are a viable technology for our energy future. They can technically and economically provide useful energy from currently wasted thermal streams and from renewable sources. In addition to being necessary for the reduction of fossil fuel consumption, Rankine cycles and other energy productivity measures should be considered as an insurance policy for high employment, high standards of living, and better balance of trade resulting from both lower oil imports and the exportation of these new high-efficiency products.

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Based on a paper contributed by the 1979 ASME Diesel and Gas Engine Power Division.

Letters & Comment

Including Discussion on Published Articles

Centennial Issue: Kudos and Comments

To the Editor:

When I read the commemorative ASME Centennial issue of *Mechanical Engineering* [Vol. 102, No. 11, Oct. 1980], I could hardly believe the quality of this special issue. Congratulations on having provided the leadership to see this project through to publication.

I was particularly impressed with the historical perspective which it provided, not only to ASME but to mechanical engineering in general. An appreciation of where mechanical engineers stand in the great sweep of history is critical to the education of young engineers today. . . .

C. T. Carley, Ph.D., P.E.
Professor and Head
Mechanical Engineering Dept.
Mississippi State University
Mississippi State, Miss.
Mem. ASME

To the Editor:

Hearty congratulations on a very excellent Centennial Issue of *Mechanical Engineering,* as it commemorates this important anniversary of the Society in a most fitting manner.

[Since I have been] associated with railroads for the past 55 years, the article "The Age of Steam," appearing on p. 4, and another on Alexander L. Holley, p. 9, were of special significance to me. Both articles included photographs of steam locomotives, with the 4-8-0 or 12-wheel type on p. 5 as a representative of heavy freight motive power at the turn of the century. The 4-4-0 American type pictured on p. 9 was the second most popular type ever built, with some 25,600 constructed between 1839 and 1928. . . .

Steam locomotives were not just a passing fancy, as there were 176,500 built by and for American railroads from 1831 through 1953. The last standard gauge locomotive was constructed by the Norfolk & Western Railway in their shops in Roanoke, Va., in December 1953. Other than models, or small types operating on nonstandard gauge trackage, the Mount Washington Railway, on the slopes of that mountain in New Hampshire, built two steam locomotives since the demise of steam on the N&W.

[When I was] employed by the former New York, New Haven & Hartford Railroad in New England, I took them apart and put them back together as an apprentice in the shop in 1925. During the 1930s, I progressed to hand firing, and then operating them on passenger trains. They were a live and vibrant machine, with the staccato blasts of steam and smoke through the stack, the clank of rods, and the melancholy whistle. These, together with the roaring fire in the boiler, all contributed to the "Iron Horse" being recognized as the principal motive power of the American railroads for over 120 years.

Arthur M. Bixby Sr.
Curator
Roanoke Transportation Museum
Roanoke, Va.
Mem. ASME

To the Editor:

First, I would like to congratulate you and your staff for the most interesting Commemorative Centennial issue of *Mechanical Engineering.* You certainly did a superb job and I shall add it to the shelf of historical references that I have established in recent years. . . .

Secondly, I note with pleasure the fact that you have mentioned Vanderbilt University on p. 33, in which passage you mention the cornerstone laying for the "new Mechanical Engineering Building." I hope that I had something to do with this reference since I mentioned that event in my book of 1975 dealing with the history of the Vanderbilt School of Engineering (10^2 Years—A Story of the First Century of the Vanderbilt School of Engineering). . . .

Dillard Jacobs
Professor of Mechanical Engineering, Emeritus
Vanderbilt University
Nashville, Tenn.

To the Editor:

I was pleased to note that two of the ASME presidents recognized and honored in your October Centennial Issue are past presidents of Bailey Controls Co. and a third was cofounder of our parent firm, Babcock & Wilcox.

All three of these gentlemen—Ervin G. Bailey and Dr. Charles E. Jones from Bailey, and George H. Babcock from Babcock & Wilcox—have made significant contributions in their respective fields and have given freely of their time and talents to ASME.

My compliments on a fine issue and a continually interesting and perceptive publication.

Marion A. Keyes
President
Bailey Controls Co.
Wickliffe, Ohio

Toward Full Professionalism

To the Editor:

Mr. Robert Zwerling's letter in the October 1980 issue [pp. 38–39] contending that engineering is a quasi profession presents a fact that the engineering "profession" continues to ignore. As a result, the engineer is not recognized as the professional individual he should be, regardless of whether he is technically registered or not.

While probably in a minority, there are many of us—academically qualified and registered engineers—who continually wonder when the technical societies (ASME included) and the state technical registration boards are going to take the positive step for achieving full (and not quasi) professionalism in engineering.

Recognizing that there are many capable and technically qualified registered engineers today who do not meet the criteria of "Models of Professions," the setting of a cutoff date in the not too distant future beyond which engineers would have to satisfy definitiveness of occupational area and intensive preparatory education prior to legal authorization to practice obtained through the professional engineering registration process would be a positive first step toward classifying engineering as a profession.

Arthur A. Aymar, P.E.
Phoenix, Ariz.
Mem. ASME

Thoughts on Freedom

To the Editor:

I read with ire the belated comments of Dr. Malik (ME, Oct. 1980, p. 38) on Professor Tesar's article (ME, Feb. 1980, pp. 34–41).

As a son of a textile worker whose father later became an AFL-CIO president [I believe that] his views, if left unchallenged, will be the downfall of democracy. I have seen for many years the injustices, exploitation, and slave labor which have been allowed to linger on in the past and . . . in many cases continue now.

Not only do farmers (I am a farmer also) go on strike; public employees are finding the strength to fight for what they feel is right and just, against those who sense they "own" the American workforce. Not only do they not own the American workforce, the Constitution of the United States and its by-laws guarantee (at least in its intent) a

workplace free from discrimination and unhealthy conditions.

... One who knew nothing about the U.S. would conclude from reading Dr. Malik's letter that the Depression was caused by labor unions since we had low industrial worker productivity! Since that time we have emerged somewhat from that horrid mire that had the American worker bound in slavery.

It appears blatantly obvious to Dr. Malik that private and government entities form their own unions and call them corporations and departments. But lo! The contempt they have for those union families who now enjoy nourishing food, decent clothing, relatively nice homes, recreation (since the workers' week is now 40 hours), and last but not least, the freedom to be middle class Americans. It seemed perfectly obvious to Dr. Malik that "freedom ... should be rationed," but it never occurred to him that freedom belongs to each of us in the United States! Power breeds contempt and poverty at all levels—union, government, and industry. ...

Patrick Lynch
University of Tennessee Space Institute
Tullahoma, Tenn.
Assoc. Mem. ASME

To the Editor:

Professor Paschkis [ME, Nov. 1980, p. 59] should venture out from his academic ivory tower and into the real world marketplace that functions due to the needs and desires of man. Our great country was founded on the basic principle of individual freedom and self-control over one's own destiny. To advocate a reduction in individual freedom by such actions as eliminating "moonlighting" is an unjustified intrusion upon the rights of the free individual and one step closer to socialism.

Please, let's not group the restraint of freedom as necessitated by safety requirements with such recommendations to reduce the "production and use of personal firearms to control crime." The attempted control of firearms has historically not affected the rate of crime. People commit crimes, firearms don't!

Charles W. Jennings, P.E.
Hixson, Tenn.
Mem. ASME

Plus ça change, plus c'est la même seal

To the Editor:

... How can *Mechanical Engineering*" describe an "EnerSav Flopack" design as a novelty? [Oct. 1980, p. 48.] Such seals have been used by European pump manufacturers for more than 40 years to reduce leakage and for deflecting the bypass liquid into the direction of the main flow to reduce turbulence.

The seal design was also described (with figure and data of efficiency-improvement) in my books about pumps, published in France in 1953 (and translated into three languages) and in a book published in the U.S. in 1964.

André Kovats
Livingston, N.J.
Mem. ASME

Free Enterprise and Energy

To the Editor:

I hope the article titled "Socio-Technical View" on p. 67 of the October 1980 *Mechanical Engineering* is not official ASME policy. It certainly is not mine.

The author shows his prejudice in the next to last paragraph by stating: "Industry and our financial institutions won't do it. So the government must ..."

I will put my bias up front. I believe that the most effective climate for assuring an adequate energy supply is the free enterprise system. If Congress had not created an artificial climate by holding down fuel prices, we would be much closer to a viable solution. While some of the alternate energy sources will hopefully become viable under any system, throwing taxpayers' money at one and all will only guarantee that more of our hard-earned money will be wasted than the "enormous" oil company profits.

The free enterprise system, without government subsidies and interference, will assure that only minimal resources will be wasted on pipedreams and that the cost-effective solutions will emerge to profit both the citizens and their sponsors.

Edgar F. Stresino
Indianapolis, Ind.
Mem. ASME

Fuel Facts

To the Editor:

In her ME News Roundup in the November issue, Joyce Moskowitz reported that combined alcohol fuel capacity resulting from certain selected projects "is expected to be about 1 billion gal/yr (3.8 billion L/yr) or enough to meet about 20 percent of the projected unleaded gasoline requirements of the nation in the early 1980s" [p. 52].

She also reported that President Carter's ambitious production capacity goal of 500 million gal of ethanol a year by the end of 1981 would meet about 10 percent of the projected 1981 requirements for unleaded gasoline in the U.S.

In view of the fact that current unleaded gasoline production amounts to about 3 million bpd, it would appear that Ms. Moskowitz is either missing a decimal point or is confusing gallons or liters with barrels. Five hundred million gallons per year works out to 32,615 barrels per day, which works out to be about 1.1 percent of current unleaded gasoline production and 1 billion gal/yr works out to be about 2.2 percent of current production.

I object to this kind of erroneous reporting because it tends to give support to certain magazine and newspaper journalists who keep insisting that our potential gasoline shortages could all be solved by making ethanol from corn, were it not for opposition from the big oil companies who fear the competition.

Paul C. Bryan
Munster, Ind.
Mem. ASME

Editor's Note:

All figures were quoted from news releases prepared by the U.S. Department of Energy, Office of Public Affairs, Washington, D.C. 20585; (202) 252-5806.

Storm Over S-T View

To the Editor:

I have read the Socio-Technical View in the *Mechanical Engineering* October 1980 issue [p. 67]. I am appalled by the sheer nonsense expressed by Mr. J. Steffens. He sounds like one of the "Nader boys." I pity him for his lack of knowledge and comprehension of technical matters as well as economics. But, he seems to embrace the elitist's gospel as expressed by the Harvard Business School study. However, their suggestions will neither solve our critical energy shortage, albeit self-imposed, nor give hope to the aspiration of working class people who would like to improve their lot. But for the elitists, those people are none of their concern; Marie Antoinette once remarked, "... if the people are hungry, give them cake." Let us only hope that the people who are responsible for the mess we are in will see the light—before it goes out.

H. F. Menzel, P.E.
Rancho Santa Fe, Calif.
Mem. ASME

To the Editor:

The Socio-Technical View ... by J. Steffens concerning the future of the nuclear energy option does not belong in a technical magazine. The fact that it appears to represent the views of an ASME division is beyond belief. The many members of the ASME that have devoted their careers to the safety of nuclear power deserve an apology. In

terms of "human perfection and mechanical perfection" the industry has a safety record that others should envy. Pursuit of absolute perfection or freedom from risk is a dreamer's way of avoiding the realities of life. A sound energy policy has to include all options that provide acceptable risks, including nuclear power. The editor of Socio-Technical View should expand his reading list from the Harvard Business School, *Our Energy Future* to pp. 77 and 78 in the same issue of *Mechanical Engineering* as a minimum. With the technical resources at its disposal, the ASME editorial policy should not duplicate the same shortsightedness demonstrated by the National Democratic Party Platform Committee.

R. B. Tupper
Past Chairman
Westmoreland Section, ASME

To the Editor:

... In this article, Mr. J. Steffens proposes the following alternatives to oil, gas, and nuclear power before 1990: conservation, solar, and wind.

According to Lord Kelvin: "If you cannot put numbers on it, you don't know what you are talking about." I submit the following numbers to satisfy the spirit of His Lordship.

Mr. Steffens writes that, according to the recent study at the Harvard Business School, *Our Energy Future:* conservation "... would save the equivalent of *all* of the oil imported from OPEC *before* 1990." (The italics are his). The validity of that study can be judged by its claim that today an unsubsidized residential solar water heater will yield a 12- to 40-percent pretax rate of return (pp. 192–3). The facts are that even in sunny California, with our 70-percent subsidy (55-percent tax credit and 6-percent interest) solar water heating is twice as expensive as heating with natural gas.

The overall contribution of solar electricity by 1990 can be evaluated from the following. According to the Department of Energy, we will need some 500×10^6 kW of additional electric generating capacity by the the year 2000 (*Electrical World,* Sept. 15, 1980). Also according to the DOE, the maximum practical goals for photovoltaics, wind, solar thermal, and ocean thermal power for the year 2000 are 20, 30, 7.5, and 2 million of equivalent kW, respectively (Solar Energy Program Document, 1980).

In order to evaluate the likelihood of reaching these goals, we should keep the following in mind: In 1973 the federal government announced the goal of eliminating all oil imports by 1980–85. In 1980 we are importing more oil than we did in 1973, in spite of a recession. In 1977 the federal government announced the goal of 10^9 bbl Strategic Petroleum Reserve by 1980. In 1980 we have a Strategic Petroleum Reserve of 91×10^6 bbl. In 1977 the California Energy Commission announced the goal of 1.5×10^6 residential solar water heaters by 1985. So far we installed some 30×10^3 since 1977.

E. Koffmann
Santa Barbara, Calif.
Life Mem. ASME

To the Editor:

... I have been told by a regular reader that *Mechanical Engineering* adopted the view that their magazine should include a broad spectrum of views on technical issues. Unfortunately, there is precious little technical content contained in the subject article. While attempting to provide a variety of "technical views" on technical issues may be a laudable objective, allowing the use of an otherwise respectable technical journal as a sounding board for presenting typical nontechnical counter-culture views is certainly not serving the interests of the engineering membership of the American Society of Mechanical Engineers. Hopefully the majority of members of ASME are still engineers rather than avant garde magazine editors.

Daniel W. Kane, P.E.
President
Council on Energy Independence
Chicago, Ill.

To the Editor:

... [The] article is an offense, not only to the intellect of all ASME members but also, it is an offense to the ASME itself! After all, nuclear power plants are designed and constructed to ASME standards. If ASME's own publication cannot understand that nuclear power plants are safe, how are we to convince the rest of the country?

... Nuclear safety does not rely on perfection, it relies on defense in depth. That is, multiple barriers, both active and passive, are placed between the reactor fuel and the environment. The failure of any one or several of these barriers is possible without releasing any radioactive materials. It takes an incredible number of failures compounded by errors in judgment to arrive at even a TMI-type accident. (An incredibly minor accident as far as the surrounding environment was concerned.) In order to get a really serious accident, very imaginative scenarios must be pursued in spite of all logic. If Mr. Steffens had actually read the Rogovin report, he would have discovered that when they said that "TMI was only 30 minutes from a meltdown," they went on to say that the results of the accident to the public would have been no different.

Perhaps the most reprehensible statement made in the article was that nuclear plants were clearly unsafe because of all of the "incidents" that are reported each year. The clear implication is that each of these incidents is a serious safety matter. In fact, the vast majority of these "incidents" are so trivial that no other industry would even report them. (Anti-nuke demonstrators at the gates, for instance, is an "incident.")

As for the supposedly riskless technologies that Mr. Steffens is so enraptured of, they are not clearly safer than nuclear power. Many are obviously more dangerous. However, Mr. Steffens adheres to the concept that ignorance of the danger constitutes safety. He assumes that the vast amount of solar energy that falls on our earth is free for the taking. In fact, it is already being used by our world for a number of life-sustaining purposes. It drives our weather, it is turned into organic energy by plants to support the food chain and to supply free oxygen, and it warms the planet so that life may exist. The amount of this sunlight that is available for conversion to energy for man's societies is not clearly understood. Recent studies of the subject of large solar installations indicate that it does not take a great deal of meddling before dire consequences result.

The National Academy of Sciences report stated that there are only two near-term energy options: coal and nuclear. At present, America is pursuing neither of these options with any vigor. Pursuing the solar phantoms instead of making the hard decisions required is a terrible threat to our nation's future. Our freedoms and our economic strength are strongly interrelated. We cannot choke off our economic lifeblood, energy, and expect to retain our freedoms for very long. The real challenge to power engineers for the rest of this century will be ... the building of power generation systems that will supply America with the power that we need at an acceptable environmental risk. ...

Charles Hess
Ringwood, N.J.

To the Editor:

In the past 4 to 6 years I have become more and more discouraged by the misinformed, populist editorials on energy alternatives in almost all the press. Now I read in my own technical society's magazine more of the same recycled litany about alternatives "that do not involve significant dangers to health and environment." The editorial in October's issue (p. 67) is the article I find

disturbing. In a few brief paragraphs it dismisses synfuels and nuclear power (and ignores coal) and then embraces 2-percent solutions to the problem such as solar, wind, ocean current, etc. In the final paragraphs it echoes the philosophy of the "technically sound" Amory Lovins and Barry Commoner "... path to a safe, sane, and sensible energy future," while dismissing the private sector in favor of government. As a final burst of an informed solution to energy problems it writes off the cost of national defense as "... useless, pointless, death-dealing military projects." ...

The goal of energy independence can best be achieved by calling upon proven energy sources, coal and nuclear, while every cost-effective alternative is searched for to supplement the primary sources. ... We need reasoned energy alternatives, not shallow soft paths that will lead us to return to the "good old days" of heat, light, and comfort from a wood-heated cave.

Chris Chapman
Richland, Wash.
Assoc. Mem. ASME

To the Editor:

As engineers, we are trained to seek facts and base our technical views on an objective evaluation of those facts. In this context, it was even more disturbing to read Mr. J. Steffens's article ... It is most unfortunate that Mr. Steffens chose as his only source the Harvard Business School study *Our Energy Future*. Had he looked further, he would have found two other studies, also published in 1979, which paint a rather different picture.[1] Concerned readers of *Mechanical Engineering* will find an excellent review of these three works by Paul L. Joskow in the Spring '80 issue of the *Bell Journal of Economics* (p. 377). If I may quote briefly from this review, the two studies cited above "make it clear that the general perception created by the Harvard study, that we can avoid all of the political and environmental problems associated with making the whole system work better by relying primarily on conservation and solar energy, is an illusion."

Mr. Steffens's comment that, "by 1990, it will be possible for solar and wind systems to be the prime energy producers ..." is a good example of the wishful thinking which pervades his article. Even the Harvard study optimistically claims only a 20- to 25-percent share of U.S. energy needs *by the year 2000* for available solar technologies. In fact, widespread application of the low-technology solar systems which could reasonably be designed and built within the next 10 years would possibly contribute 2 quads of energy, rather than the 5-quad figure cited in *Energy Future*.

Mr. Steffens's comments on nuclear power are also unfounded. Nuclear energy has been and is being "safely produced." Barriers to solution of the nuclear waste "problem" are political, not technical. And as for nuclear safety requiring human and mechanical perfection, does Mr. Steffens demand perfection of every technology that entails risk? Nuclear power plant design, construction, and operation are carried out with far more control and attention to safety than most of our other technical activities. Finally, the statements regarding "events" and "incidents" are so misleading as to be simply irresponsible. I suggest Mr. Steffens read some of the Kemeny Commission staff reports or the June 1980 issue of the *EPRI Journal* to get the facts. The Commission concluded that it required an unrealistic denial of remedial action to achieve a meltdown. Even then, there would have been no significant release to the atmosphere and little or no propagation. This conclusion was confirmed by the Rogoven study.

In summary, conservation, solar and other energy alternatives deserve additional development, but abandoning the proven technologies of coal and nuclear power would be imprudent and potentially disastrous. Greater efficiency in using *all* of our energy resources, together with increasing supplies of energy from existing technologies, is the only viable path to reducing our dependence on imported oil. Suggesting that there are simplistic solutions which rely only on "alternative" energy sources is a disservice to the engineering profession and to the public at large.

F. W. Kramer, P.E.
Pittsburgh, Pa.
Mem. ASME

To the Editor:

... J. Steffens apparently suggests absolute perfection is required for safety. What is meant by absolute perfection? Perhaps a fairly coherent significance can be attached to the expression "perfect government" or "perfectly rigid body" in terms of a limiting or ideal state of a property already empirically in an object or situation. But to speak of perfection, as such, is very different, and the conception of something absolutely perfect—perfect in every respect and not in any specific respect, is not readily intelligible. It is so vague that whatever properties we do assign to it are assigned either arbitrarily, or out of purely subjective preference.

If our society were to be founded on this suggested premise—then we would not have the technological advances our country now enjoys. ...

The scare phrase, "So let's look at some other energy alternatives that do not involve significant dangers to health and environment" is typical of those individuals who spend more time talking about problems, and less time finding positive solutions.

The same day I read this article I heard about an accident in a Kentucky coal mine that killed three persons. This was the second fatal coal mine accident in Kentucky within several weeks. Does this mean we should close down all the coal mine operations?

What about the lives that were lost when an offshore oil rig collapsed? ...

J. B. Silverwood, P.E.
Philadelphia, Pa.
Mem. ASME

To the Editor:

... The paragraph on nuclear tries hard to portray a disaster about to happen. That may well be the opinion of Mr. Steffens, but I rather doubt that it is the opinion of any mechanical engineer who has seriously considered nuclear energy.

Remarkably, Mr. Steffens has totally ignored coal.

Mr. Steffens's hope that the utilities invest in solar is a good example of his lack of knowledge in what is allowable for utility investment. ...

Forrest T. Rhodes
Burlington, Kan.
Mem. ASME

To the Editor:

My colleagues and I from the ASME Committee on Nuclear Quality Assurance are extremely disturbed by the article ... sponsored by the Technology and Society Division in the October 1980 issue of *Mechanical Engineering*. Our Committee, which has extensive, in-depth knowledge and experience with both nuclear power plants and fuel cycle facilities, finds Mr. Steffens's paragraph on "Nuclear" to be misleading and particularly ill-informed in its technical conclusions.

For example, Mr. Steffens indicates that electricity from nuclear power cannot be produced safely. This is in direct contradiction to a study funded and adopted by the American Medical Association that stated conclusively that of all presently available technologies for generation of large amounts of electricity, the nuclear option is the *safest*. Mr. Steffens also discussed the "unsolved nuclear waste problem." The American Physical Society, in a recent report, clearly states that the technology to

[1] *Energy: The Next Twenty Years,* A Report sponsored by the Ford Foundation and administered by Resources for the Future, Ballinger, Cambridge, Mass., 1979.
Energy in America's Future: The Choices Before Us, A study by the staff of the RFF National Energy Strategies Project, Johns Hopkins University Press, Baltimore, Md., 1979.

safely store nuclear wastes exists and is practical. Widespread use of this technology is simply awaiting a green light from government. In short, the waste disposal problem is not technical but purely bureaucratic.

Mr. Steffens also fails to mention the bottom-line conclusion of the Rogovin Report, which says that they "... rejected a recommendation that there be a moratorium on operating reactors or on granting new operating licenses on reactors now under construction and nearing completion." Additionally, this oversimplified analysis appears to spill over into his discussion of other alternatives as he, with the stroke of his pen, removes any significant environmental or health impact from dams, ocean current turbines, and fermentation of the entire U.S. corn crop.

I strongly believe that the editors of *Mechanical Engineering* have a responsibility to maintain the reputation of this ASME publication as a forum for articles by professionals who have a depth of knowledge and experience in the subjects they are addressing, and whose conclusions and opinions have sound technical bases.

To have an article of such bias and misrepresentation appear in our society's professional publication is a disservice to the standards of professionalism of the society.

Jack E. Vessely
Chairman
ASME Committee on Nuclear Quality Assurance
Miami, Fla.
Mem. ASME

To the Editor:

The "Socio-Technical View" sponsored by the Technology & Society Division and published in the October issue of *Mechanical Engineering* continues their tradition of "editorializing" in a manner with which, I believe, the overwhelming majority of ASME members would vehemently disagree. I believe the pontifications are erroneous, misleading, and present simplistic solutions to difficult problems. . . .

It is long overdue that the ASME magazine editor add a prominent additional disclaimer to all such "editorializing" articles stating, on that same page, that these are not necessarily the views of the ASME nor any significant number of its engineers. The present single disclaimer, applying equally to all the contents [p. 3], may protect the ASME legally, but does not serve the society's purpose adequately for articles such as these.

Arthur L. Ross, Eng. ScD, P.E.
Bala Cynwyd, Pa.
Mem. ASME

To the Editor:

It has been extremely frustrating over the last several years to be bombarded by heavily biased, anti-nuclear opinions presented by U.S. news media that [are] technically uneducated. Now I find I must bear more of the same, but this time from an ASME monthly journal that my dues money helps to support.

. . . Barry Commoner of the Citizens Party would be delighted to receive this editorial evidence of the technical society's lack of support for the nuclear option. Is it also possible that ASME publications [are] becoming a battleground of propaganda for promoting the self-interests of highly competitive, energy-related fields, without the proper editorial constraints owed to, and expected by the Society membership? I make note of the statement from the Society By-Laws (B7, Par. 3), "ASME shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications," and wonder what can be done to prevent the battleground scenario.

H. R. Freelburn
Windsor, Conn.

To the Editor:

In my opinion, diatribes on political issues such as appeared in the Socio-Technical View in October do not belong in *Mechanical Engineering*.

I happen to believe that complete deregulation of energy would be in the best interest of our country. Price controls on natural gas and petroleum have led to overconsumption of these resources and have disrupted major industries (see "The Wreck of the Auto Industry," *Harper's*, Nov. 1980). I do not, however, consider it appropriate for me or anyone who shares my point of view to launch an intemperate harangue against those who take another position.

I think that I am correct in saying that the prices of oil and gas have been only partially deregulated. Natural gas prices have been nominally deregulated but the bureaucratic constraints have not been fully removed and full deregulation of oil is not even scheduled until September of next year.

The windfall profits tax is, in my opinion, another example of counterproductive political action; but, if there is to be such a tax, the proceeds should certainly go to the development of alternative energy sources rather than to buy votes for the politicians.

J. R. Hamm
Export, Pa.
Mem. ASME

To the Editor:

. . . [Mr. Steffens] rails at an undesignated "they" who have "deregulated the price of gas and oil," causing "double-digit inflation." He implies duplicity by "they" in blaming it on OPEC; then, "they" passed the windfall profits tax to provide the funds for development of alternative energy supplies that "require despoliation of the land and air and water pollution." Finally, he insists that only *government* can solve all the problems to be overcome in devising a "path to a safe, sane, and sensible energy future." Who . . . does he think "they" are? Where has he been not to recognize that his "solution," viz., government actions, created the problems and is inherently incapable of providing a real solution?

To recapitulate, it was the government, under the design of the liberal social-engineers in the Congress, that regulated and allocated our energy supplies to make the taxpayer subsidize the consumer (another example of a "transfer" program) to insulate him from the real cost of energy. It was the government programs that so reduced energy company domestic incentives that profitability could only be maintained by foreign investments. Then, when those foreign investments were confiscated (nationalized) by their governments, our government found it had created a mechanism whereby other nations (OPEC) could profitably blackmail us! . . .

L. Bernath, Ph.D., P.E.
San Diego, Calif.
Mem. ASME

To the Editor:

J. Steffens . . . appears to be one of those who view the current energy crisis as an opportunity to make radical changes to our society. An appropriate subtitle for the column would be "Social Engineering through Crisis Management." The column opens with ominously conspiratorial allusions to some entity "they," who are now obscenely profiting from the deregulation of gas and oil. All the while, (according to Steffens), worthwhile "alternatives" languish on the sidelines for the want of a few more megabucks from the government. Steffens demands perfection, human and mechanical, for nuclear energy, but then dismisses this as an (obviously) unattainable goal. But, on the other hand, even though he admits there are problems with the alternatives, "the problem is not insurmountable." It's all so simple, all we have to do is divert government resources away from "death-dealing military projects to technologies that promise a better life."

Let Lovins and Commoner and Nader have their say. But let us, as engineers, put their views, as well as those of the "hard" technologists, to the test of critical evaluation, and not merely parrot one side's views or the other's. This is the way we can best serve society.

Bruce C. Slifer, P.E.
Northboro, Mass.
Mem. ASME

Briefing the Record

News from Current Engineering Reports and Magazines • Samuel Walters

Probing the Secrets of Vulcan

On May 18, 1980, when Mount St. Helens erupted, the American public awoke to the reality of volcanic phenomena. The turbulent clouds, molten rock, and acrid smells of a volcanic eruption are indeed awesome. To the scientist, too, a volcanic eruption is an awesome spectacle, but a volcano, whether active or inactive, is a fascinating natural laboratory. The location, age, and distinctive features of volcanic fields provide clues to the activity going on beneath the earth's cust. Erupted lavas, volcanic ejecta, and gases provide information on the composition and processes of our planet's interior. Within the U.S. during the last 150 yr, volcanoes have erupted in Alaska, Hawaii, California, and most recently in Washington.

Volcanic hazards are multiple: lava flows that endanger communities; volcanic ash that may ruin water supplies, crops, villages, and cities; and gases that can severely corrode machinery and vehicles and endanger health.

But there is also a positive side. On the positive side, young volcanoes overlie great reservoirs of heat energy that can be used for heating and generating electricity. Ash falls, in moderate amounts, enrich the soils around volcanoes. In many tropical countries, they are necessary for renewal of the soil and continued agricultural use of the land.

Of course an understanding of volcanoes, their causes, and their activity is necessary before we can develop them as sources of heat or avoid their hazards. Such understanding flows in significant measure from the work of of volcanologists, atmospheric chemists, and meteorologists. Volcanologists, for example, are contributing to the search for alternative energy sources. It is known that young volcanoes overlie masses of molten or partly molten rock that are located a few kilometers to several tens of kilometers deep. These heat reservoirs provide the energy for the highest grade geothermal resources available to us in the U.S. Some of the larger hot rock masses may have volumes of hundreds to thousands of cubic kilometers and can take up to 2 million yr to cool to the ambient temperature of the earth's crust if they are not reheated by the intrusion of new magma. Each mass holds an enormous amount of thermal energy. A small amount of this energy is transferred to the surface during the interaction with ground water to produce geysers, hot springs, and natural steam fields, but most of the heat remains locked into the rock, cooled very slowly by conduction into the surrounding area.

In its Hot Dry Rock Geothermal Project, LASL is experimenting with man-made geothermal systems designed to extract this heat for direct use or for the generation of electricity. At an experimental site near Los Alamos, two deep wells in natural hot dry rock are connected with a man-made hydraulic fracture. Water is circulated through the loop, where the temperatures are as high as 200°C, to produce hot water and steam. Because the highest-grade geothermal resources are associated with volcanic fields, work at LASL is directed at understanding the "plumbing" below these fields, its role as a heat source, and its relation to surface features such as volcanic vents and large volcanic collapse features.

LASL research on the present physical and mineralogical properties of these volcanic deposits, formed during explosive eruptions nearly 15 million yr ago, may provide acceptable locations for the storage of nuclear wastes. Of interest are old, thick volcanic ash deposits located in isolated parts of the western U.S. LASL scientists are studying deposits in Nevada that consisted of glassy, silica-rich volcanic ash particles that were transformed into zeolites and other minerals during interaction with circulating groundwater. Zeolite minerals have internal crystal structures consisting of open frameworks that allow them to be used commercially to filter radionuclides from contaminated effluents. The zeolite-rich, thick volcanic ash deposits would thus act as a natural barrier against radionuclide migration from a nuclear-waste repository.

Volcanology is an actively growing science and there is much to be learned. Accumulating data on phenomena preceding eruptions can help develop the capability for prediction, in order to understand and cope with the potential hazards to man. But we also must increase our understanding of the beneficial aspects. For example, the eruption of Mount St. Helens caused tragedy for many people, but it also pointed out that within the Cascade Range is a large geothermal resource to be developed.

Recording Fluid Currents by Holography

Convection in fluids can be studied with the aid of a holographic apparatus that reveals the three-dimensional motion of the fluid. The apparatus eliminates images of fixed particles such as dust on windows and lenses, which might mask the behavior of moving fluid particles.

The holographic flowmeter records multiple-exposure holographic images of "microballoon" particles intentionally introduced in the fluid. The velocity and direction of streams in the fluid are found by measuring the distances between reconstructed images of a particle and dividing by the time between exposures.

The holographic apparatus was developed for experiments on fluid convection cells under zero gravity. The principle is adaptable to the study of a variety of fluid processes—for example, electrochemical plating and combustion in automotive engines.

In the present form of the apparatus, microballoons (100-μm-dia, neutrally buoyant, hollow glass particles) are suspended in a water-filled cell that has four transparent plastic sides and two aluminum sides (see figure). One of the aluminum sides is heated while the other is cooled, so that convection currents are created in the water. A beam from a helium/neon laser passes through the cell and strikes a photographic film. A reference beam from the same laser also strikes the film, without passing through the cell. The two beams produce interference patterns that contain information about the positions of the microballoons in the cell.

The film is exposed four times; the first two exposures are separated by 2 s, the second and third by 8 s, and the third and fourth by 4 s. When the holographic image on the film is reconstructed, the multiple exposures show the successive positions of microballoons as they are moved by convection currents. The velocities of the microballoons are computed from the distances

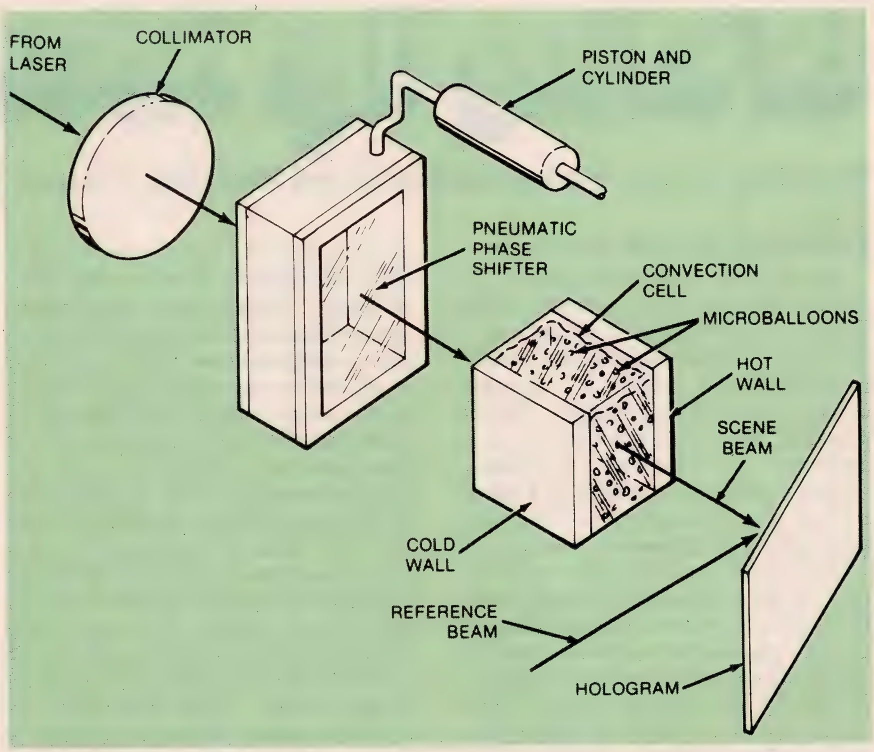
between successive images and the known interval between exposures.

Between the second and third exposures, the beam passing through the cell is shifted in phase by 180 deg. This phase shift cancels images of fixed particles that may have been recorded on the film during the first two exposures. Without this background "noise," the moving particles are much easier to discern.

A simple glass microscope slide serves as the phase shifter. Rotation of the glass from a position normal to the scene beam to a new position 3 deg away from the normal changes the path of the beam by ½ wavelength, corresponding to a 180-deg phase shift.

In a planned phase shifter, the primary beam would be passed through an air cell before passing through the convection cell. The pressure in the air cell is varied by a piston, and the light passing through it is advanced or retarded in phase. A pressure change of 0.115 atm (0.16×10^5 N/m^3) in a cell with windows separated by 1 cm is sufficient to shift the phase by 180 deg.

This work was done by Lee O. Heflinger and Ralph F. Wuerker of TRW, Inc., for Marshall Space Flight Center.



The key to a noise-free recording of moving-particle positions is a shift in phase of the laser beam passing through the convection cell. Although simply rotating a glass plate from a plane normal to the beam will shift the phase, the proposed pneumatic phase shifter shown here would be more precise. Altering the pressure of the air in the shifter alters the phase of the light passing through it.

Neutrinos and the Nature of the Universe

A NASA scientist has found new evidence suggesting that the subatomic particles known as neutrinos may have mass, and that our galaxy may be surrounded by vast numbers of neutrinos which were produced during the first few moments of the birth of the universe. Until recently, neutrinos were thought to have no mass, like photons.

Dr. Floyd W. Stecker, of the Laboratory for High Energy Astrophysics at the Goddard Space Flight Center, Greenbelt, Md., says there may be new astronomical evidence based on a recent suggestion by CERN (Centre Européen de Recherches Nucleaires) phsyicist A. de Rujula and Nobel laureate Sheldon Glashow of Harvard University that if neutrinos have mass, evidence for their decay might be found in ultraviolet astronomical observations.

Stecker, writing in the Oct. 27 issue of *Physical Review Letters,* concludes that tentative evidence of a spectral line, which may be from decaying neutrinos, exists near the ultraviolet wavelength of 0.00017 mm in various rocket observations.

Ultraviolet astronomical observations can only be made above the earth's atmosphere, with rockets and satellites. Stecker used rocket observations by Dr. Richard Henry of Johns Hopkins University and his collaborators as well as observations of a French group working with data from the French D2-B spacecraft.

The hypothesis, if it is correct, holds important implications for theories dealing with the nature of all matter and the ultimate fate of the universe.

The strength of emission lines from ultraviolet spectroscopy gives important evidence on the rate of decay, which in turn is inversely proportional to lifetime. Stecker believes that if his interpretation of the ultraviolet data is correct, these neutrinos live so long that only one neutrino in 10 million would have decayed since the universe began (under the Big Bang theory of cosmic evolution).

According to the Big Bang theory, all of the matter of our present universe was originally packed together in a primeval fireball—an extremely hot, dense ball that exploded about 15 billion yr ago. The gigantic explosion threw hydrogen, helium, electrons, and radiation out into space. The matter that was spewed into space expanded and cooled, and several million years later it condensed into galaxies. The universe has continued to expand, and the galaxies have continued moving away from each other ever since.

One part of the Big Bang theory states that there are roughly a billion neutrinos for every proton in the universe. (Protons are the nuclei of hydrogen atoms, which account for 90 percent of the atoms in the universe.) Our galaxy may be surrounded by a spherical sea or "halo" of neutrinos that were created in the first moments of the Big Bang, some of which are decaying all the time.

If Stecker's conjecture is correct, the "heavy" neutrinos which produce this spectral line at the observed wavelength would weigh so little that it would take a billion of them to equal the weight of one nitrogen atom. However, there are so many of them that they would make up the bulk of the mass of the universe and account for the mysterious "missing mass" in large clusters of galaxies.

Stecker's mass estimates agree with recent reports by a group at the Institute for Theoretical and Experimental Physics in Moscow. Other recent evidence for neutrinos having mass has been reported by a group at the University of California at Irvine under Dr. Frederick Reines.

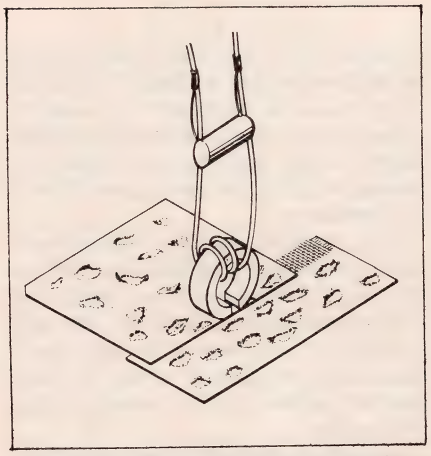
The determination of the fundamental properties of neutrinos, such as their mass and lifetime, provides important clues to understanding the nature of all matter. In addition, the exact determination of the masses of all types of neutrinos (of which three are presently known) will enable astrophysicists, using the general theory of relativity, to deduce whether the universe will keep on expanding forever or will eventually collapse, producing a new Big Bang.

Plastic Welder

A low-cost, self-contained, and portable welding system developed at Langley Research Center joins plastic parts by induction heating. The device can be used in any atmosphere or in a vacuum, and the plastic components can be joined in situ.

Conventional methods used to join thermoplastics and composites include adhesives, fusing, and mechanical fasteners (e.g., using nuts and bolts or rivets). Adhesives are not reliable when parts are exposed to a vacuum, and fusing often deforms the plastic and causes it to flow around a joint. Mechanical fasteners require hole preparation and special hardware; riveting, if heat is used, can cause hole defomration; and nuts and bolts may require two people for assembly, especially with large sheets. Induction heating, however, causes little or no deformation at the joints, utilizes few component parts, and can be used with almost any type of thermoplastic.

A modified, wound, toroidal inductor core (see illustration) is used to transfer magnetic flux through the thermoplastic to a carbon steel screen. The airgap cut into the toroid diverts the path of the magnetic flux from the toroid to the screen.



Inductive-heating welder joins plastic sheets thermally. The low 25- to 100-W power required readily permits it to be battery- or solar-powered and self-contained. Various configurations of the plastic welder could be used in the aerospace industry and in the automobile, furniture, and construction industries.

Typically the metal screen would be cut into long strips 1/4 in. (0.64 cm) wide and sandwiched between sheets of plastic at a joint to join one sheet of plastic to another or to join a plastic sheet to a structural beam. The airgap of the toroid is placed on one of the plastic surfaces directly above the screen. When the toroid is energized, the alternating current produces inductive heating in the screen, causing the plastic surfaces on either side of the screen to melt and flow into the screen and forming the joint. The temperature of the screen is determined by such factors as the input power, number of coil windings, width of the airgap, and the frequency of the alternating current. The toroid is moved along the seam or joint at a controlled speed to produce optimum joining.

This work was done by John D. Buckley, Robert L. Fox, and Robert J. Swaim of Langley Research Center. For further information, contact: Howard J. Osborn, Langley Research Center, Mail Code: 279, Hampton, Va. 23665. (Refer to LAR-12540.)

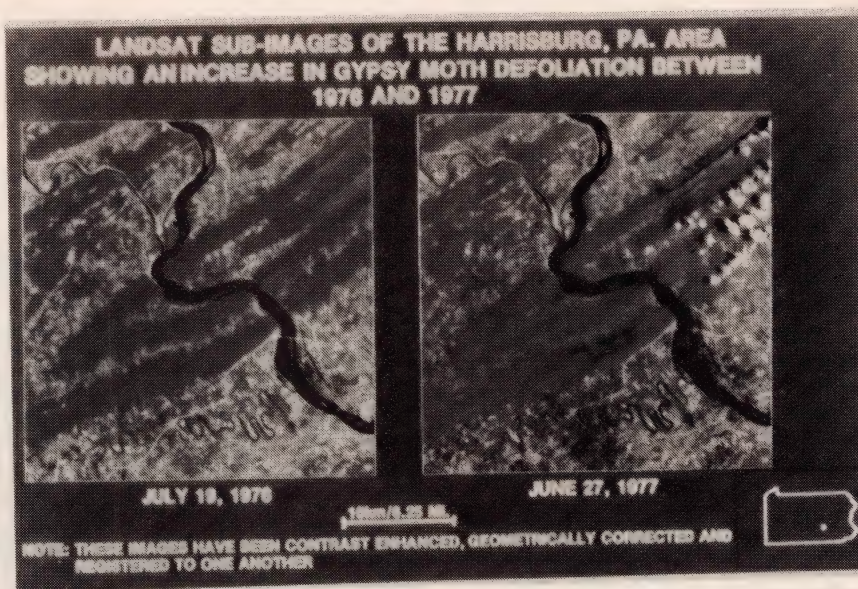
Monitoring the Gypsy Moth

A three-year pilot program to develop and demonstrate the capability of using Landsat satellite data to detect and monitor gypsy moth damage in Pennsylvania forests has been started by NASA and the Pennsylvania Department of Environmental Resources.

The gypsy moth caterpillar, which primarily inhabits the northeastern U.S., feeds primarily on the leaves of hardwood trees, such as oak and maple. In 1980 alone, the caterpillars defoliated 178,062 hectares of hardwood forests in Pennsylvania. Over the past 10 years, gypsy moth damage to the hardwood forests of Pennsylvania has been estimated at $32,000,000.

The pilot program uses multispectral scanner data from NASA's Landsat satellites to examine hardwood forests conditions before and after defoliation occurs. This procedure allows forested areas exhibiting gypsy moth damage to be identified and located on the satellite image so that analysis of subsequent satellite imagery can be concentrated on monitoring those areas affected.

By updating the satellite imagery, foresters will be able to identify which forested areas are infested, as well as which areas to isolate for pest management activities. These satellite monitoring techniques should improve on conventional aerial sketch mapping methods, which are inadequate, costly, and nonstandardized.



These photos, taken in earlier tests, show the damage created by gypsy moths to hardwood forest areas around Harrisburg, Pa. The area along ridge at top right-hand corner of the 1977 image indicates extent of damage made by insects. Another area, near center of same picture on right, is darkened and shows where moths have defoliated area west of the river.

The results of this pilot program will be used to inform other states in the eastern U.S. of techniques that they can employ to control the southwestward spread of the gypsy moth in hardwood forests since it was initially mapped in New England in 1910.

During the program, the Landsat imagery will also be used to generate a mosaic of the entire Keystone State. Each Landsat image covers an area 300 km^2.

The Landsat multispectral scanners, which are used to collect these data, measure green, red, and infrared light being reflected off the surface of the earth by the sun. These measurements are then transformed into images and recorded on digital tapes by computer processing for future analysis.

Acoustic Emission Testing

A new space-age technology—acoustic emissions analysis—has been acquired by Hartford Steam Boiler Inspection and Insurance through its acquisition of AE International Inc., a high-technology testing firm located in Richland, Wash. Acoustic emissions analysis is an advanced nondestructive testing technique spawned by the Space Age. It uses sophisticated electronics and computer equipment to first detect minute energy or sound signals generated by discontinuities in materials under stress. Once detected, followup analysis of these signals verifies the location and structural significance of each particular discontinuity.

Some of the most common discontinuities to which acoustic emission techniques are applied include: stress corrosion cracking, weld cracks, porosity and inclusions, cladding cracking and disbonding, laminations, fatigue cracks, and hydrogen embrittlement cracking. These discontinuities occur commonly, and can be detected through the application of acoustic emissions techniques in a wide variety of structures and equipment. The technique is applicable to a wide range of materials, including wood, plastic, fiberglass, concrete, and metals of all sorts.

Acoustic emission analysis offers advantages over traditional nondestructive testing techniques in many situations. Most notable is the ability to conduct a complete structural integrity analysis during a fast, one-step test, while requiring only limited access and little or no downtime.

Also, acoustic emission testing evaluates the structural significance of flaws that may be inaccessible to traditional NDT techniques. Obviously, the advantages in not having to shut down equipment, or empty vessels of their contents, offers a major saving in time and money.

It is a dynamic testing technique that can warn of serious flaws during pressure testing of containment systems, thus affording an early-warning system for impending failure. Once having detected such flaws, plant owners and operators can then initiate subsequent shutdowns, and corrective measures can then be taken to stave off potentially dangerous conditions or ultimate failures of the vessels or structures.

These advantages have made acoustic emissions testing an important tool in verifying the soundness of nuclear plant containment systems, petrochemical and chemical vessels and piping, offshore production platforms, bridges, and pipelines.

Typically, the acoustic emissions inspection involves the use and placement of a limited number of transducers at accessible locations that are predetermined by structural renderings and surveys of the piece. Transducers detect minute pulses of energy caused by applied stress. Those pulses or "sounds" are amplified as much as 500,000 to 1,000,000 times and are then processed for analysis by a series of high-speed computers.

One, called a real-time source display system, shows the location and intensity of all emissions on a video screen. Another, the source analysis computer, conducts a complete statistical analysis of all incoming signals, and prints out the location, relative significance, and statistical accuracy of the sources on a hard copy scaled layout of the structure undergoing inspection.

The computer map and video display provide the inspection team, comprised of AE technicians and inspectors trained by AE International, with the vital information necessary to complete an accurate integrity evaluation. The data are used to prepare an on-site report of the integrity inspection, which lists the number and location of discontinuities detected, and grades them as to their significance to structural integrity.

Selecting Welded Wire Assemblies for Strength

A welded wire assembly is a component part that has been fabricated of steel wires welded together into one unit. Until recently, these components—used in equipment, vehicles, and products—grew immensely in popularity for two reasons: They drastically reduced both the weight and the cost of parts they replaced.

Now, in a new trend, welded wireforms are being increasingly chosen as components for a hitherto unrecognized quality. They offer strengths that are comparable, or in many instances, superior, to castings, molded plastic, and sheet metal housings.

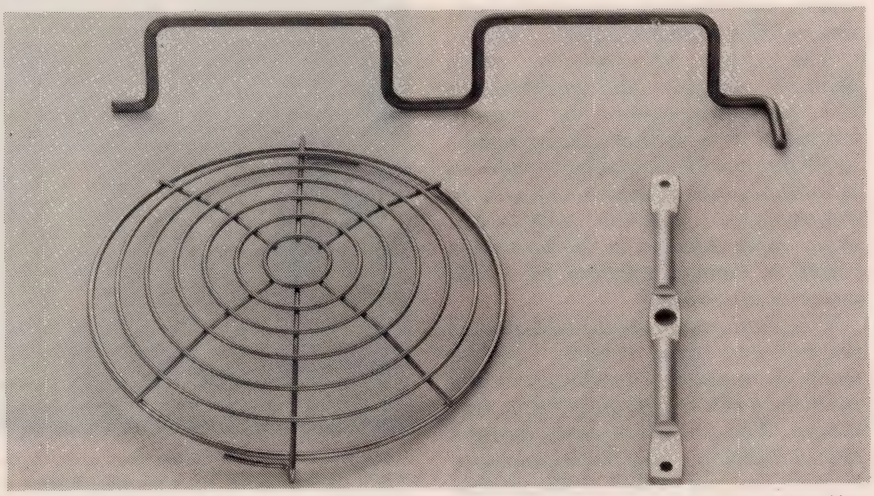


Photo illustrates three features of steel wire and wireforms: at top, bending makes wire stronger (than straight wire) because of the mechanical property enhancements that are a direct result of cold working; at left, a part composed essentially of concentric wire rings is the strongest of all welded wireform shapes; at right, swaging strengthens the wire sections where holes are necessary.

Wire has one of the highest strength-to-weight ratios of any form of steel. That's because yield strength, tensile strength, and hardness are greatly increased as steel rod is cold-drawn through wire-forming dies. Even wire for the lowly paper clip has far higher tensile strength than the common grades of structural steel (typically 50,000 psi, or 345 MPa). There are fine wires that can attain tensile strengths approaching 500,000 psi (3450 MPa), although the gages used in wireforms generally range from 60,000 to 90,000 psi (414–621 MPa).

Strength can be heightened by applying the principles of efficient design. One of the leading creative fabricators in the wireform business, E. H. Titchener & Co., of Binghamton, N.Y., has developed a set of guidelines to gain the utmost strength from a welded wireform. Their tips:

- Wireforms are fashioned mainly of low-carbon (AISI 1005 to 1012) and medium-low-carbon (AISI 1013 to 1022) steel wires for their formability, weldability, and strength. The higher the

carbon content, the stronger the wire, and this range can provide tensile strengths up to 150,000 psi (1034 MPa). Carbon contents higher than the 0.23 percent of AISI 1022 present welding problems and are usually not used in these constructions.

- Wireform components are normally made from wire diameters that range from 0.048 in. to 1/2 in. (1.22–12.7 mm). Doubling the diameter is not necessary to double the strength. For example, a structure that must support 20 lb (9 kg) will often take 1/4-in.-dia (6.35-mm) wire. Surprisingly, for one that must hold a 100-lb (45-kg) load, 5/16-in. (7.94-mm) wire is frequently selected.
- Where it's feasible in the configuration of the part, wireform strength is increased by a four-sided box shape. The box often offers the strengthening possibilities of bridge or truss construction, via connecting pieces, which distributes load equally along high and low points on many areas of the wire assembly.
- When they are compatible with a particular application, concentric rings are actually one of the strongest of all wireform configurations. They spread the load around a full 360 deg rather than a few tangent points. Wires that connect the circles add to the strength pattern.
- Wire fabricators are not reluctant to employ the strengthening effects of stampings, strip, sheet, tubing, or machined bar stock to further brace a design. These nonwire elements also add flat surfaces for mounting holes or RF shielding.
- Where pierced holes are necessary, swaging is done. This cold working flattens sections of a wire (limited to a thickness of about half the wire diameter), making it harder and stronger in the swaged areas. Since punctures weaken wire, compensate by specifying stock of a slightly larger diameter. The structure should also be designed so that areas of major load do not fall on pierced wire.
- Sometimes, threads are required on the wire ends to provide a means of attaching other components. Specify rolled thread in preference to machine-cut. Roll threading (less expensive and faster) is cold-formed by passing blank wire through two threading dies. It is stronger because the steel is displaced instead of removed.
- Mechanical fasteners are made an integral part of wire assemblies by using weld nuts, studs, screws, or other fasteners specially designed for projection welding. These save both time and cost in wire assemblies without sacrificing strength or significantly increasing weight.
- Miscellaneous: (*a*) The vast majority of wireforms are made from round wire. However, more costly shaped wires—oval, triangular, square, flat, hexagonal, and grooved—are available to meet extra strength requirements. (*b*) Where longer wear is needed, formed wire parts can be case hardened by heat treating.
- Last but all-important is the choice of welding process. Recommended techniques: Cross wire (resistance) welding at the tangent point is the simplest, most practical, and reliable, with multiple welding contributing to reduced cost; the heli-arc system of line welding is used where wires are parallel to one another; projection welding is the choice when wire has to be welded to strip or other material.

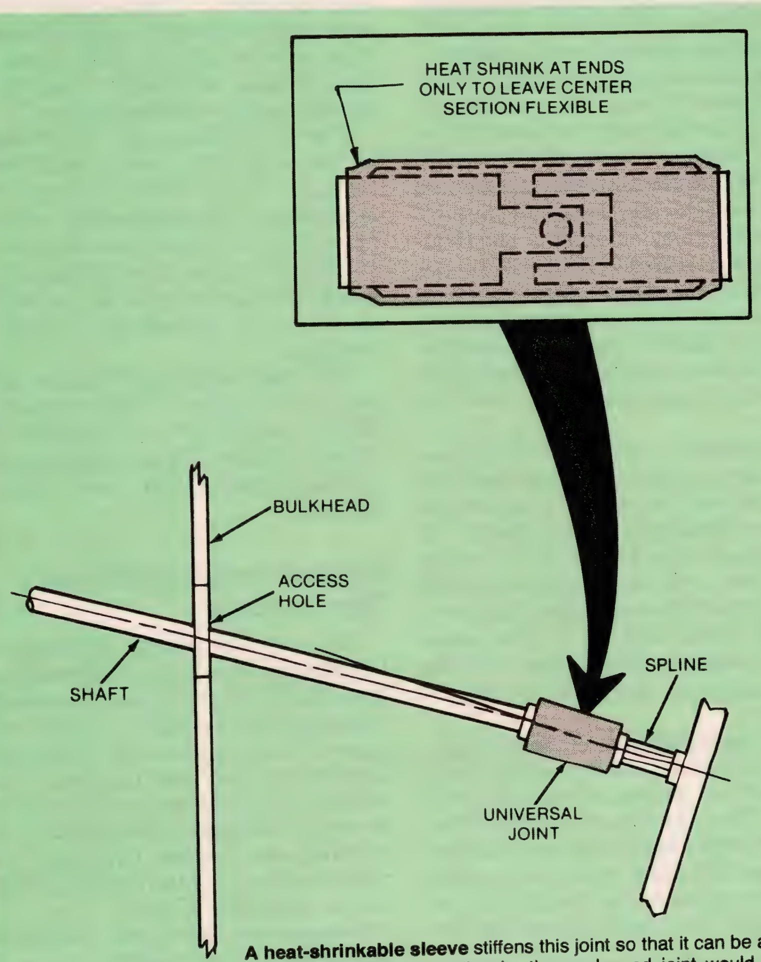
Heat-Shrinkable Sleeve Aids in Installing Universal Joints

Heat-shrinkable tubing, normally used as electrical insulation on wire and cable, is now being applied in a new and quite different way—to "stiffen" universal joints so they can be attached to other structural members in confined spaces. This innovative technique, which saves considerable time and effort when assembling nonrigid parts, makes it unnecessary to use special holding fixtures or tools. In addition, the tubing also protects the joint from dust and other contamination.

The method was developed for attaching a universal joint on the end of a shaft to a spline fitting, where access to the spline is only through a small hole in a bulkhead (see figure). The tendency of the joint to "droop" under the pull of gravity makes it difficult to aline it with the spline.

To overcome this problem, assemblers place a length of heat-shrinkable tubing over the joint, as shown, and apply heat at the ends to shrink it in place. This stiffens the joint sufficiently so that it is easily alined with the spline. After the parts are joined, the sleeve remains in place as a shield against contamination. It is flexible enough so that it does not interfere with normal motion of the joint.

This work was done by William S. Green and Fredrick W. Thompson of Rockwell International Corp. for Johnson Space Center.



A heat-shrinkable sleeve stiffens this joint so that it can be aligned with a spline fitting. Previously, the unsleeved joint would droop, making it difficult to attach it to the splines.

Fuel-Efficient Unit Heater

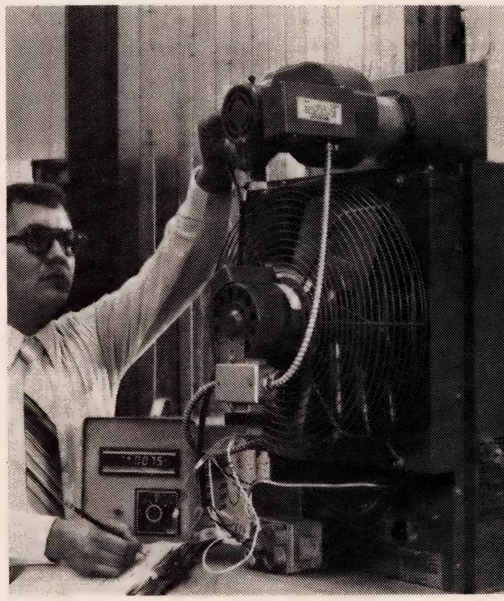
A unit space heater available for industrial and commercial buildings reduces fuel costs up to 20 percent, depending on the installation and venting configuration, says ITT Reznor, a division of the International Telephone and Telegraph Corp. The gas-fired unit, called the "Venturion,"™ is designed for horizontal power venting instead of conventional gravity venting. With sealed flue collection and power venting, the Venturion greatly reduces the loss of heated room air during on and off cycles. By reducing losses, the Venturion can maintain desired comfort levels in shorter operating cycles. In multi-unit installations, fewer Venturion heaters are required to achieve desired operating results.

The power venting of the Venturion also permits the use of a smaller-diameter vent pipe and achieves further savings because horizontal venting through a side wall is less costly to install than the trouble-prone roof venting required for a conventional unit.

Based on a fuel cost projection by the Department of Energy, cumulative fuel savings in a 10-year period, depending on geographic location, could amount to over $35,000, on a building with heat loss of 1 million Btu.

Reznor first developed and marketed gas-fired unit heaters in the early 1930s, and pioneered many advances in heating and air-conditioning technology. ITT Reznor claims the Venturion is the most timely and important product introduced in the company's 90-year history.

"There's no question that the number-one priority today is fuel efficiency," said Charles H. Bremer, ITT Reznor's director of marketing. "Of course, ours isn't the only industry facing the need to develop more fuel-efficient equipment. Fortunately, we began working on the problem before the energy crunch hit, so we are a few steps ahead of our competition," he added.



Each ITT Reznor "Venturion,"™ according to a company official, undergoes a series of rigorous quality controls tests before being shipped.

NASA Detects Changes in Sun's Energy Output

Using a new type of measuring device flown in space for the first time, a NASA satellite has detected small changes—over periods of days to months—in the brightness of the sun. The instrument, called an active cavity radiometer irradiance monitor—included for one of seven experiments on the satellite—is capable of detecting changes in the sun's release of energy as small as one thousandth of 1 percent. The instrument measures a very broad range (X-rays to radio waves) of the radiation that falls on top of Earth's upper atmosphere. This represents well over 99.9 percent of the total solar radiation reaching Earth.

Theoretically, an increase or decrease in the sun's release of energy—as little as 0.5 percent per century—can produce profound changes in Earth's climate. It is estimated that a drop of only 1 percent in the sun's output of radiation would decrease Earth's mean global temperature by more than 1°C. The entire Earth would be covered with ice if the sun's radiation decreased by only 6 percent.

The entire history of humankind, lived out in the last several million years, has occurred during abnormally cold times. There is evidence that Earth has been growing colder for about 90 million years, and scientists believe the average global temperature may drop 10 or more degrees in the next several million years.

One-hundred-fifty million years ago, Earth was approximately 8°C warmer than it is today. Since then, numerous warming and cooling climatic cycles have occurred. These cycles, which occur with frequencies ranging from 22 yr to millions of years, have caused ice ages, ranging in severity from major glacial epochs to "little ice ages."

The last "little ice age," which began in the mid-17th century and lasted through the mid-19th century, was marked by a $1\frac{1}{2}$-degree drop from the present mean global temperature of about 14°C. This slight change in the Earth's average temperature resulted in an observable increase of glaciation in the Alps.

The Solar Maximum Mission satellite, launched into a 575-km orbit above Earth last Feb. 14, is managed for NASA's Office of Space Science by the Goddard Space Flight Center, Greenbelt, Md.

Pollution Problem in Energy-Tight Buildings

The push for energy efficiency in buildings is not without its hazards, an Iowa State University professor warns. "Buildings can be made too tight," says James Wood, professor of mechanical engineering and architecture. "By sealing all of the cracks and holes to reduce air infiltration, the building's atmosphere becomes less 'forgiving.' The residual capacity of the building to help indoor air quality is lost."

Conventional structures usually exchange inside for outside air once each hour. But in energy-efficient buildings, this exchange is cut by 50 percent or more, Woods says. This reduction can result in higher concentrations of indoor-generated pollutants.

Woods is head of the ISU Building Energy Utilization Laboratory, which is researching energy use and conservation in buildings, and how this affects building occupants. One aspect of this research is indoor air quality.

He is also chairman of the ventilation standards committee of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, which is revising nationally recommended standards for ventilation.

Indoor air pollutants emanate from three principal sources, Woods says: materials used in the construction and equipping of the building, and the building's occupants and their activities.

Materials and equipment affecting indoor air quality include:

- Energy-efficient earthen construction materials such as brick and concrete. These materials normally contain trace elements such as uranium, radium, radon, and radon isotopes which emit radioactive gases.
- Glues used in a variety of construction materials. Some vaporize formaldehyde, which, in low concentrations, may cause eye and respiratory tract irritation, and in high concentrations may cause coughing and chest constriction. Urea-formaldehyde foam insulation, burning of natural gas, and tobacco smoke also emit formaldehyde, Woods said.
- High-intensity lighting, such as metal halide lights. These emit signif-

icant levels of energy in the ultraviolet range, increasing occupant exposure to possible cancer-causing light waves, Woods said.

- Electromagnetic contamination. Investigation into this area is just beginning, Wood said. Possible sources are microwave transmissions and microwave ovens with deteriorated door seals.

Tobacco smoke and bio-effluents are the primary pollutants generated by building occupants.

Both the smoke exhaled by the smoker (mainstream) and smoke from the burning tobacco (sidestream) affect indoor air quality, but Woods notes that sidestream smoke is more hazardous because it has not been filtered by the smoker's lungs.

"Smoking can be especially serious in energy-efficient buildings. The energy efficiency code adopted by the state of Iowa contains only the minimum ASHRAE standard for air changes per hour. But the minimum standard is only one-half or one-third the recommended level," he said.

Humans emit approximately 15 bio-effluents that have been identified, he said, and in high concentrations, some may cause health problems. High levels of carbon dioxide, for example, can cause nervous system disorders.

Communicable disease germs are another potentially hazardous bio-effluent, and pose a greater health hazard in improperly ventilated areas.

What people do inside buildings also affects air quality. For example, even relatively low concentrations of chemical vapors from copy machines have been shown to be carcinogenic, Woods said.

Woods suggests three methods of controlling indoor pollutants:

- Source control—Regulate spaces where smoking is permitted and put vapor barriers around areas where hazardous chemicals, such as copy fluids, are used.
- Dilution—Bring in sufficient quantities of outside air to dilute concentrations of indoor pollutants. Use an air-to-air heat exchange to preheat and precool outside air in summer to save energy. Use natural ventilation during periods of moderate temperature.
- Mechanical removal—Use filters, air cleaners, or heating/cooling coils to remove pollutants.

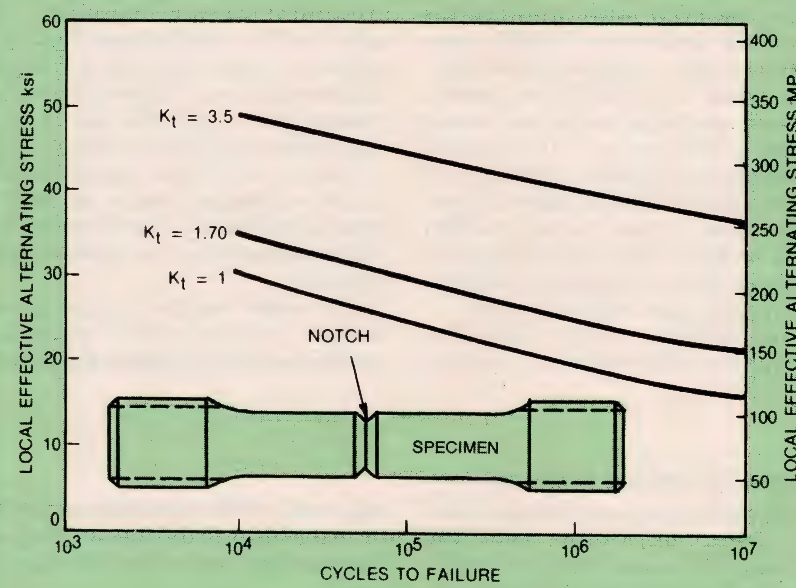
"One of our projects is to develop variable ventilation control strategies. We're studying a wing of a Minneapolis junior high building, using carbon dioxide produced by the occupants as a sensor for ventilation control. Results of this research are very promising," Woods said.

Predicting Lifetime of Cast Parts

The life expectancy of cast aluminum machine parts can be predicted accurately from fatigue tests at 78 K on notched specimens of the aluminum alloy. The method was developed for rocket-engine turbopump parts made of high-strength, heat-treatable alloy with high silicon content; however, the technique is applicable to other aluminum-casting alloys.

The notched specimens produce test results that more accurately reflect actual part performance than do the smooth specimens previously used. In addition, the test data are far less scattered with the notched specimens. Design curves based on the test data predict the lifetime of a part for any stress state and mean stress, over the range of stress concentrations spanned by the data.

Specimens for the tests were taken from a sandcasting of a turbopump part and were machined and heat-treated like the part. A groove was cut around the specimen at its center (see figure). The radius at the bottom of the notch was selected to give the desired stress concentration. For example, with a 0.009-in. (0.229-mm) radius, the elastic stress concentration factor K_t is 3.5. The specimens were subjected to a sinusoidally varying axial load until they fractured at the notch. The ratio of minimum to maximum alternating stress was −1 (that is, equal but opposite stress) for some specimens, 0 for others (stress alternated between zero and a maximum value without changing direction), and +0.5 for still others (the minimum stress was one-half the maximum). The specimens were cooled with liquid nitrogen to a temperature of −320° F (78 K) to accelerate failure and thus reduce the time required for the test.



Part lifetime increases with decreasing stress and stress concentration. In this plot, the ratio of minimum to maximum cyclical axial load is −1.0. The values of K_t represent stress concentration, with K_t= 1 being the value for an unnotched, smooth specimen.

The local effective alternating stress and the peak stress were calculated for each specimen from its geometry and loading. The results were plotted as stress versus cycles to failure.

The same procedure can be used to develop similar plots for other parts. The only difference is that the notch radius should be altered to correspond to the stress concentration in the part. From such plots, a designer can readily observe the influence of stress and stress concentration on operating life.

This work was done by R. A. Cooper of Rockwell International Corp. for Marshall Space Flight Center. For further information, contact: Leon D. Wofford, Jr., George C. Marshall Space Flight Center, Marshall Space Flight Center, Ala. 35812. (Refer to MFS-19549.)

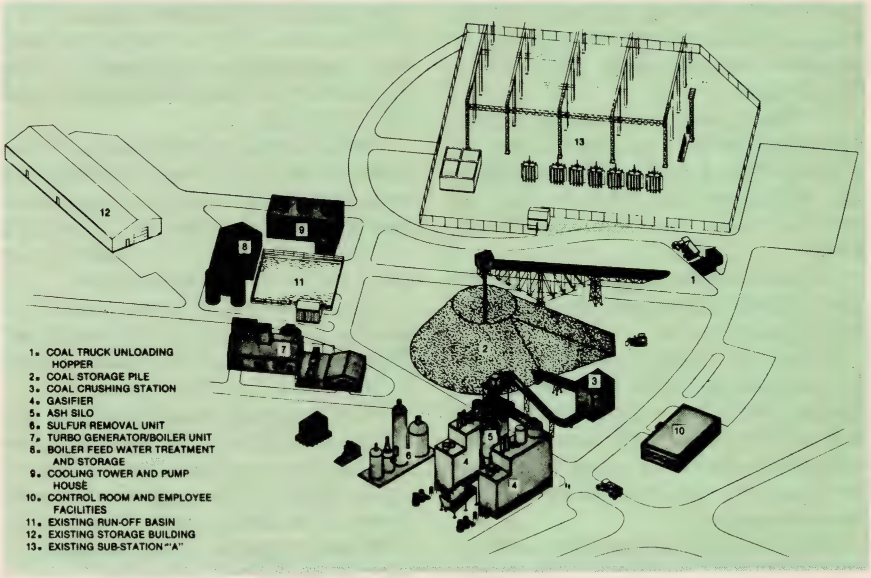
Unique Power Plant

A feasibility study has confirmed expectations for a unique power plant that could be built at NASA's Lewis Research Center, Cleveland, Ohio. The plant would use high-sulfur coal without polluting the atmosphere, and extract twice as much energy from the coal as under conventional methods.

Known technically as a coal gasifier cogeneration power plant, the facility would gasify high-sulfur coal to produce a clean fuel gas, burn the gas to produce electricity, and recover waste heat to produce more electricity as well as heat for the Lewis Center's 130 buildings and test facilities. Cost: $50 to 70 million.

Describing the proposed project, Dr. John F. McCarthy Jr., Lewis director, said that "the technology involved would be applicable potentially to the electric utility industry and to any industrial plant that is a heavy user of electrical and heat energy. Significantly, the plant would use proven technologies in coal gasification and cogeneration, which means that commercial validity could be established in much less time than needed to prove new technologies."

The feasibility study provided the conceptual design for a 20-MW power plant at Lewis. That would be sufficient power to furnish the center's baseload electrical needs and steam necessary for heating. It would be equivalent to the power needed to supply the electrical needs of approximately 5000 homes. Peak steam capability would be 90,000 lb/hr (40,000 kg/h), a rate equal to that required for the average medium-sized industrial plant.



This is the preliminary design for the 20-MW power plant the NASA Lewis Research Center intends to build at its 350-acre (140-ha) complex in Cleveland, Ohio. Unique in the world, the plant would convert high-sulfur coal into electricity and steam for the center's 130 buildings and test facilities without polluting and with twice the coal energy output possible in conventional generating plants.

In an operating version of the plant, crushed coal is blown into a fluidized bed gasifier (a vertical, cylindrical tank). There, the coal reacts with steam and air at a temperature of about 1800°F (980°C). Thus, the coal is efficiently converted into a raw fuel gas which is drawn off at the top of the gasifier. The sulfur in the coal becomes hydrogen sulfide and comes out of the tank as part of the raw fuel gas. A nonleaching, environmentally acceptable ash is withdrawn from the bottom of the gasifier.

The hot raw fuel gas is cooled down in a heat exchanger where its heat is transferred to water, thereby generating high-pressure steam for eventual use in a turbine.

The cooled fuel gas is then passed through a cleanup system where suspended particles and gaseous pollutants are removed. The hydrogen sulfide in the gas is converted to elemental sulfur and recovered in the form of a powdered cake. There are a number of ways to dispose of sulfur in this form that have negligible impact on the environment.

The cleaned fuel gas is then burned in a gas turbine which drives a generator for the production of electricity. The hot exhaust from the gas turbine—normally vented to the atmosphere and thus wasted—is then directed through a heat exchanger where it produces high-pressure steam. This steam is combined with that produced in the raw gas cooler and is used either to power a steam turbine which can produce additional electricity or, as low-pressure steam, provide heating for buildings.

'Brakes' of Driving Analyzed

How accelerating and braking affect fuel consumption in urban traffic was the focus of a recent study by traffic scientists at the General Motors Research Laboratories, Warren, Mich.

Most fuel-conscious drivers are aware that they can reduce automotive fuel consumption if they avoid braking by foreseeing necessary stops and then decrease speed by coasting. The researchers—Paul Wasielewski, Leonard Evans, and Dr. Man-Feng Chang—were able to quantify the importance of anticipating these starts in city driving.

The energy dissipated in braking is wasted, they note. If the brakes were not applied, a driver could make use of kinetic energy to travel an additional distance unpowered—with no further need for the engine to supply tractive energy.

By analyzing available data from two large-scale traffic observational studies, the researchers found that in the speed range in which most urban driving takes place:

- An average of about 50 percent of the energy supplied at the wheels is used for acceleration, and is thus transformed into kinetic energy.
- Two-thirds of the kinetic energy resulting from acceleration (that is, one third of the total tractive energy) is dissipated by braking.
- On the average, 30 percent of the length of each trip between a start and a stop is covered while coasting or braking.

A high correlation was observed between energy used in accelerating and energy dissipated in braking, thus suggested that fuel-saving behavior—anticipating starts and stops—rarely occurred in the cases studied.

Wasielewski, Evans, and Chang focused their research on traffic variables previously shown to be related to fuel consumption, particularly the relationships among energy used to accelerate the vehicle, energy dissipated in braking, and mean traffic speed.

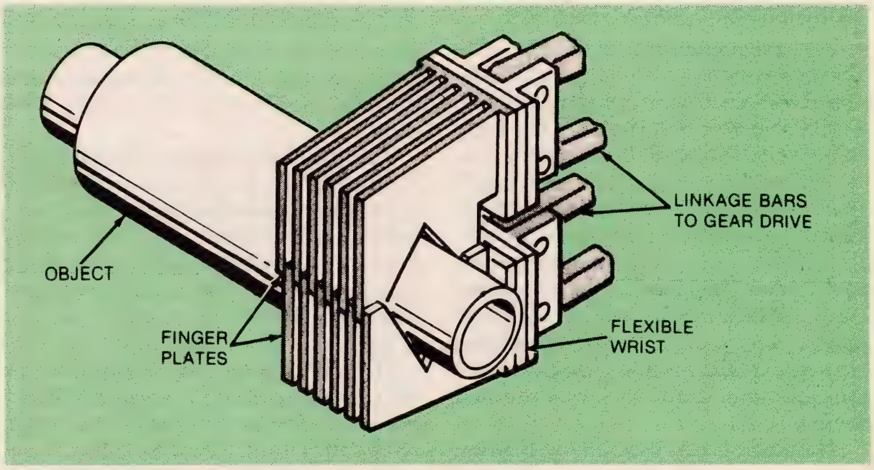
Analysis was based on data previously collected by other researchers in two separate studies of traffic characteristics in a number of metropolitan areas. The surveys involved 28,000 mi (45,000 km) of driving and included six cities—Los Angeles, Chicago, New York, Houston, Cincinnati, and Detroit.

The traffic researchers reported their findings in a recent SAE technical paper, "Automobile Braking Energy, Acceleration and Speed in City Traffic."

Remote Mechanical Hand

An improved end effector serves as a "hand" for a remote-manipulator spacecraft system to grasp objects of various sizes. The device has a built-in flexible wrist-joint "cartilage" for increased gripping force without significant strain on the mechanical connections.

Two identical jaws are used to grip objects (see figure). Each jaw has a set of laterally spaced finger plates. The plates of one jaw are set off from the other so that they intermesh when the jaws are closed. An object is held by V-shaped notches running across each jaw. These notches allow objects as small as a wire or as large as the notch to be gripped firmly.



This end effector has interlocking finger plates to grip an object, and can grasp objects as small as wires and up to the size fitting the V-notches.

Each jaw is driven by a pair of parallel linkage bars coupled to the corresponding wrist joints by a pair of spaced pivots. The pivot support plate is separated from an integral finger backplate by a flexible material such as synthetic rubber. This material, held to the plates by rivets or brads, forms the flexible wrist joint.

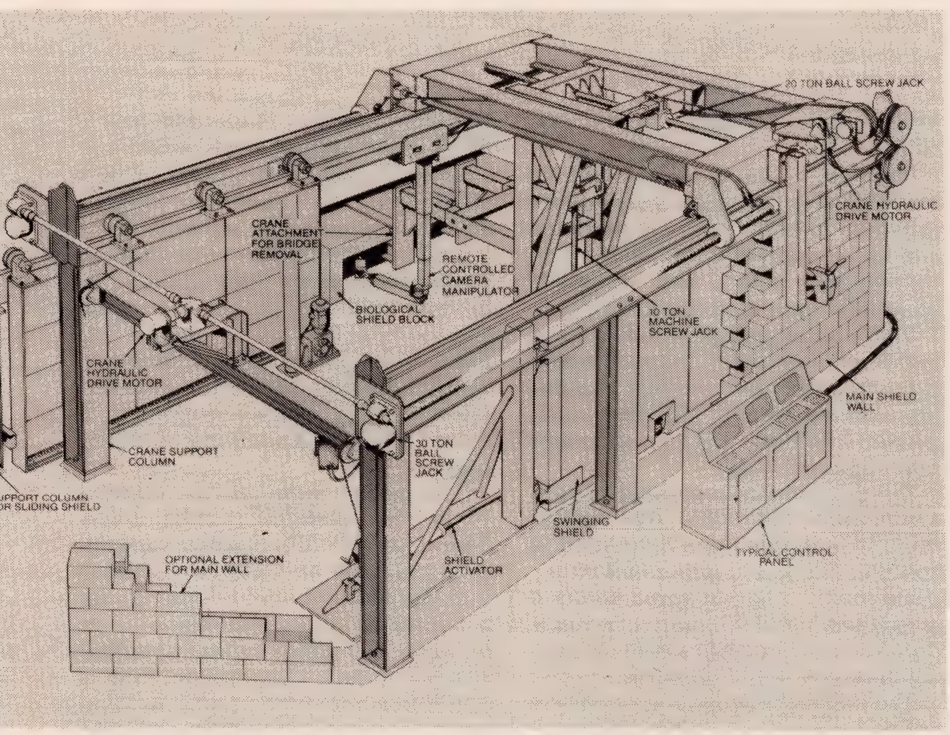
The opposite ends of the parallel linkage bars attach to a pair of spaced plates enclosing a gear mechanism. Each inner linkage bar is rigidly joined to a gear plate, and the gear plates mesh with a bevel gear driven by an electric motor directly behind.

The end effector is guided toward a target object by a mechanical arm linked with the central control station. The object is approached with the jaws wide open. Once the jaws are aligned with the object, the bevel gear is activated to close the jaws.

This work was done by Keith H. Clark and James D. Johnston of Marshall Space Flight Center. For further information, contact: Leon D. Wofford, Jr., Marshall Space Flight Center, Mail Code: CC01, Marshall Space Flight Center, Ala. 35812. (Refer to MFS-23692.)

Robot System Assists in Nuclear Plant Repairs

Welding six faulty pipes is ordinarily not a major operation—except when those pipes are in the highly radioactive depths of a nuclear power plant. That was the situation recently faced by Ontario Hydro and Atomic Energy of Canada Ltd. To help solve this problem, they turned to Pow-R-Jac, Lynchburg, Va., manufacturer of mechanical linear motion systems.



View of the Limitorque Corporation's Pow-R-Jac Robot System.

Small leaks in the labyrinth of the reactor's calandria necessitated repair, but would subject workmen to lethal doses of radiation within minutes. So a unique robot crane was designed in cooperation with site engineers to permit workers to complete critical welding operations from a protected position by means of a remotely controlled manipulator monitored by TV.

Designed to provide three-axis motion (up–down, north–south, east–west), the robot crane provides the precise positioning accuracy required for the delicate repair operation. Incorporating a tandem system of 10-, 20-, and 30-ton electrically operated machine and ball screw jacks, the lift carriage is designed with screw-in tension and operates at infinitely variable speeds of from 0 to 4 fpm (1.2 m/min). The travel carriage provides north–south positioning with the screw alternating from compression to tension. The frame movement is east–west. The screw alternates between tension and compression, and the travel nut operates from zero to 10 fpm (3 m/min).

Operators raise, shift, and lower the robot to remove U-bolts, clean pipes, weld patches, and install new supports.

Coal-Based Energy Sources

Recognizing the importance of coal to the nation's long-term energy future, the Gas Research Institute has undertaken a $400,000 study to evaluate the comparative advantages of converting coal to higher-quality gaseous and liquid fuels and to electric power. In order to identify an optimum strategoy for utilizing this country's coal resources, while at the same time minimizing consumer costs, the GRI study considers the entire energy sector from coal conversion through transmission, distribution, storage, and end use as a unified system.

The study is divided into two distinct phases. The first phase is a detailed engineering cost comparison of coal gasification, liquefaction, and steam electric power generation. Work under this phase will be performed by Bechtel National, Inc., under the direction of Dr. Ab Flowers, director of GRI's Supply Research Div. The second phase is a study of end-use costs and efficiencies, in which total system costs will be compared. This phase will be undertaken by Booz-Allen & Hamilton, Inc., under the direction of Kenneth G. Darrow, manager of economic analysis at GRI.

The total study is being guided by an independent task force comprised of executives from combination gas and electric utilities and of representatives from the Electric Power Research Institute, American Natural Resources Co., the Energy Productivity Center of the Mellon Institute, the MIT Energy Laboratory, and the University of Bridgeport. Through such broad representation, the task force hopes to ensure that the viewpoints of a representative cross section of the energy community are incorporated into the study.

The task force suggested that initially the Bechtel phase consider first-generation (commercially proved) coal conversion technologies and that subsequently it consider second-generation (ready for demonstration) technologies. The coal conversion technologies selected are shown in the table.

HYGAS will be used in place of the BGC/slagging Lurgi if adequate information cannot be obtained on the design of the BGC unit. For the sake of cost estimates, construction of first-generation coal conversion plants is based on a 1980 start, while construction of second-generation plants is estimated to begin in 1985.

The city of Chicago will be the first consumer region to be analyzed. Other consumer regions will be considered in subsequent analyses.

The primary objective of the second phase of the study is to make time-based comparisons of the costs and efficiencies of the use of coal-derived gas, oil, and electricity for space conditioning for both residences and commercial buildings on a regional basis. These comparisons will take into account such specific factors as cost of owning and operating equipment, storage costs and requirements, seasonal effects, peak loads, building type and thermal properties, and characteristics of heating, ventilating, and air-conditioning equipment.

This approach involves:

- Establishing a set of hypothetical, yet realistic, building/HVAC system test cases under carefully specified assumptions.
- Undertaking thermal load and energy use calculations based on typical weather data for both heating and cooling modes.
- Analyzing comparative costs both on a life-cycle basis and on the basis of energy costs alone. Included in the analysis will be customer costs of owning and operating space conditioning equipment (capital, fuel, maintenance), as well as energy transmission, distribution, and storage costs.

	First-Generation Technology	Second-Generation Technology
Coal to Electricity	Coal-fired power plant with flue gas desulfurization	Texaco gasification/combined cycle
Coal to SNG	Lurgi gasification	British Gas Corp. (BGC)/slagging Lurgi or HYGAS
Coal to Oil (No. 2 Fuel Oil Equivalent)	Lurgi/Fischer-Tropsch	H-coal

Trend to the Diesel

In the U.S., gasoline engines are used in many applications that are routinely assigned to diesels overseas. But this is rapidly changing, particularly since the 1973 Arab oil embargo. Subsequent to that event and the energy crisis it foreshadowed, American industry has become increasingly aware of the reasons for turning to the diesel—less maintenance, longer life expectancy, and greater fuel efficiency. As a consequence, it has been suggested that the 1980s in the U.S. will be the decade of the diesel.

Anticipating this trend a decade ago, Onan Corp., the leading U.S. manufacturer of diesels with ratings under 50 hp, began a $100 million research and development program to design and manufacture a new line of modern industrial state-of-the-art engines. Two series of engines in the size range of 10 to 115 hp are planned. The first of these, the L-Series Model L-423 four-cylinder diesel, will go into production in July 1981 at Onan's Huntsville, Ala., facility.

Eventually, the L Series will be available with two, three, four, and six cylinders in both naturally aspirated and turbocharged models. They will be water-cooled, have a high maximum speed (3600 rpm), and be made in 30- to 115-hp sizes for applications including: mobile refrigeration, pumps, compaction equipment, intermediate tractors, turf care equipment, trenchers, compressors, forklifts, welders, generator sets, and marine use.

The full L-Series is expected to be in production by early 1985. By mid-1981, Onan's Huntsville plant is expected to produce diesels at a rate of 50000 engines yearly. Current plans are for a second new series of diesels to be introduced in the mid-1980s aimed at meeting the power needs of the 90s.

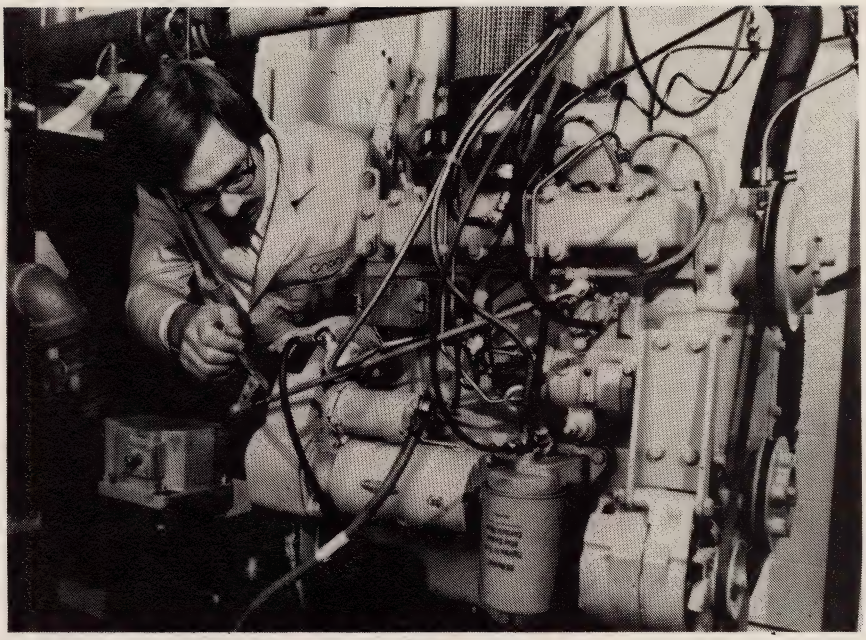
The L-Series is designed for mobile as well as stationary applications, although the on-highway market is not a primary target application. The engines have a 35-cu-in. per cylinder displacement and a vertical in-line configuration. It is a metric design that can be turbocharged, and all accessories are available from one side. Power ratings are as follows: two cylinders, 27 hp; three cylinders, 41 hp; four cylinders, 55 hp; four cylinders-turbocharged, 76 hp; and six cylinders-turbocharged, 115 hp. Standard features include: distributor-type fuel injection pump, indirect injection, 12-V starter motor, 37-A alternator, and glow plugs.

The engines have an iron cylinder block with integral cylinder bores. There is a six-bolt head pattern and the cylinders have an 0.180-in. (4.6-mm) wall thickness. Cam bushings are replaceable and there is provision for an oil cooler and piston cooling on turbocharged models. The cylinder head is iron with a cross-flow porting arrangement. There are two valves per cylinder and a push-rod type valve train. Rocker

arms are made of stamped steel. A Ricardo Comet Mark V combustion system is standard, but a direct injection combustion system, within capability of production tooling, is planned. The critical valve bridge area is force cooled. Valve guides are replaceable, as are valve seat inserts. The crankshaft is made of ductile iron with five main bearings on four cylinder engines and seven bearings on six cylinder units. Crankshaft sections and bearings are sized for turbocharged operation at 1700-psi (11.7-MPa) peak cylinder pressure.

The gear train employs helical gears and is located at the front of the engine. The fuel injection pump, camshaft, and oil pump are all gear-driven and there is a 60-hp auxiliary gear drive. The fuel injection system employs self-cleaning pintle-type injectors, a distributor-type injection pump, and a mechanical-type transfer pump.

In laboratory testing the engine has been run 25,000 hr with 16,000 hr of this at full intermittent ratings. Current field tests include units on a transport refrigeration system, a skid steer loader, a forklift truck, and a trencher.



Testing on prototypes of Onan's new L Series diesel engine family goes on round the clock at the firm's J. C. Hoiby Technical Center. Above, Greg Kvidera, Field Test Coordinating Engineer, makes adjustment on four-cylinder L 423, in one of the Center's computerized test cells.

Onan Corp., a subsidiary of McGraw-Edison Co., is currently installing state-of-the-art production lines and computer-controlled test cells for manufacture of the new engines at its Huntsville plant.

Suppressing Jet Buzz-Saw Noise

Buzz-saw noise, the most annoying noise component generated by turbofan engines, can be suppressed by installing a porous surface on the duct wall (see figure) directly above the engine fan-blade tip. The porous surface and its housing would reduce the shock-wave reflection from the wall and thus suppress the noise.

Turbofan engine fans produce both tonal and random noises. When the fan-blade tip is supersonic, the tonal noise dominates. Shock- and expansion-wave patterns that constitute the tonal noise are formed at the blade tips. This shock, together with the resulting interacting patterns, rotates inside the duct and propagates out as a strong pulse forming the so-called buzz-saw noise that dominates over the noise produced by the blade-passing frequency and its harmonics.

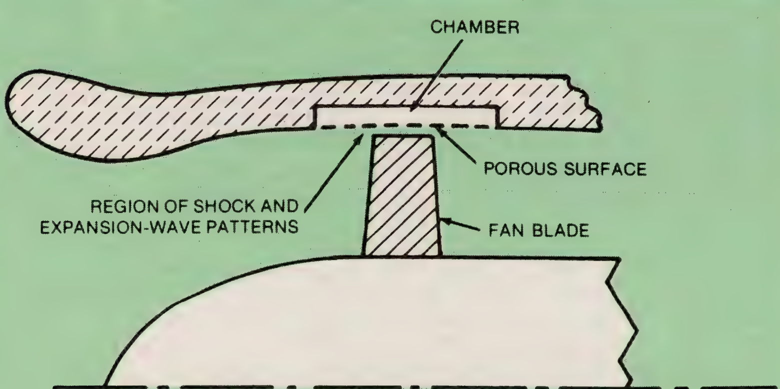
The proposed approach uses a technique successfully tested in suppressing the jet-noise shock in which a shock wave resulting from a large pressure gradient in the flow originating at the outer tip of the engine nozzle is eliminated. A similar approach can be used to suppress the shock formed by the jet-engine air blade.

The turbofan duct wall in the vicinity of the blade tip would include a porous surface that can suppress direct shock and expansion waves impinging on the wall. Waves reflected from the duct wall are suppressed due to absorption by the porous surface. A chamber behind the porous surface acts like a pressure stabilizer.

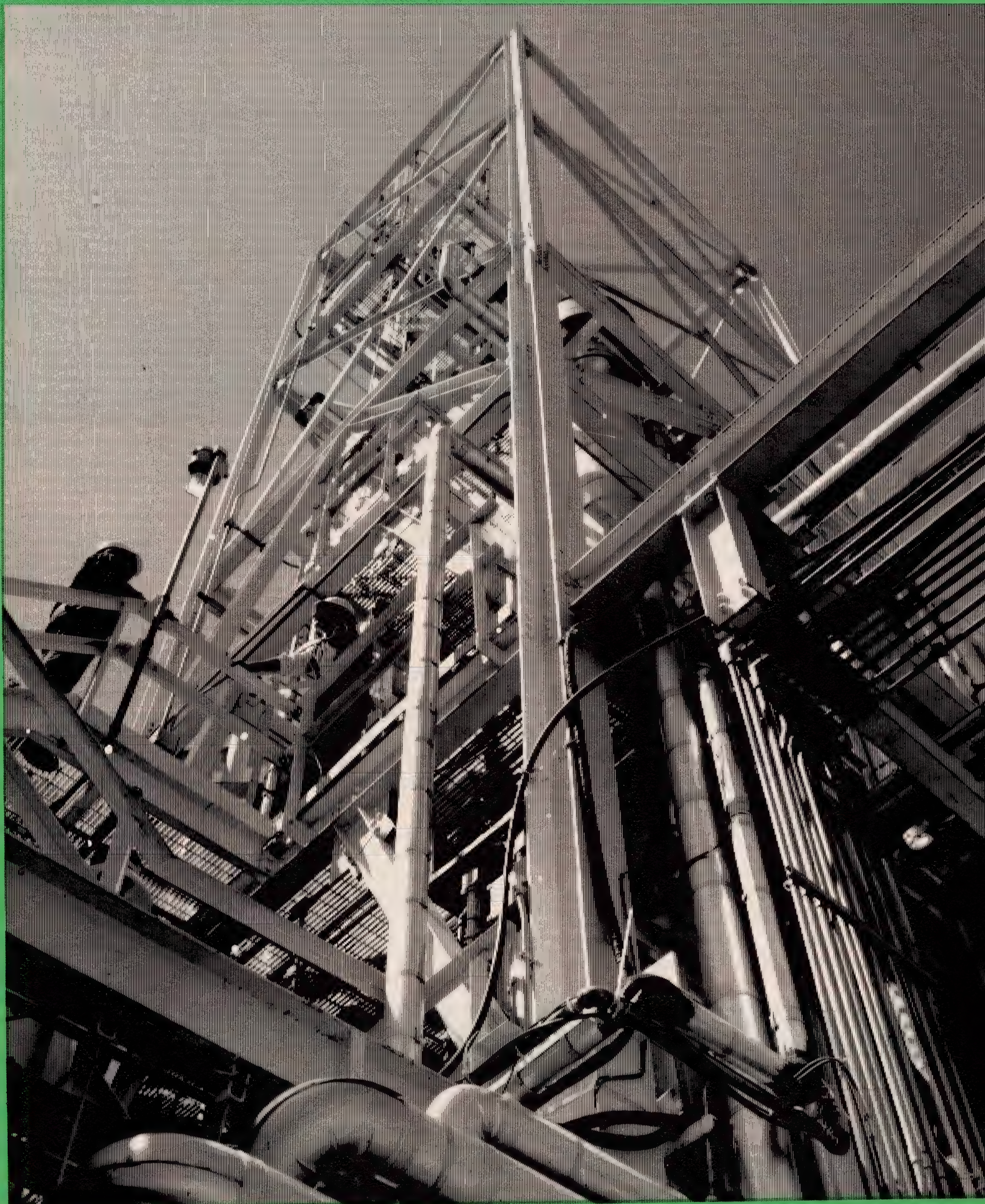
Aerodynamically, a shock impinging on the porous surface reflects as an expansion wave, while it reflects as a shock over the nonporous part of the surface. As it is reflected, the resulting interacting patterns (compression and expansion waves) cancel each other's contributions. This effect has been observed experimentally.

This work was done by Lucio Maestrello of Langley Research Center. Further information may be found in *NASA TM-78802* (*N79-13820/NSP*), "Initial Results of a Porous Plug Nozzle for Supersonic Jet Noise Suppression" ($5). A copy may be purchased (prepayment required) from the National Technical Information Service, Springfield, Va. 22161.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Langley Research Center, Mail Code: 279, Hampton, Va. 23665. (Refer to Lar-12645.)



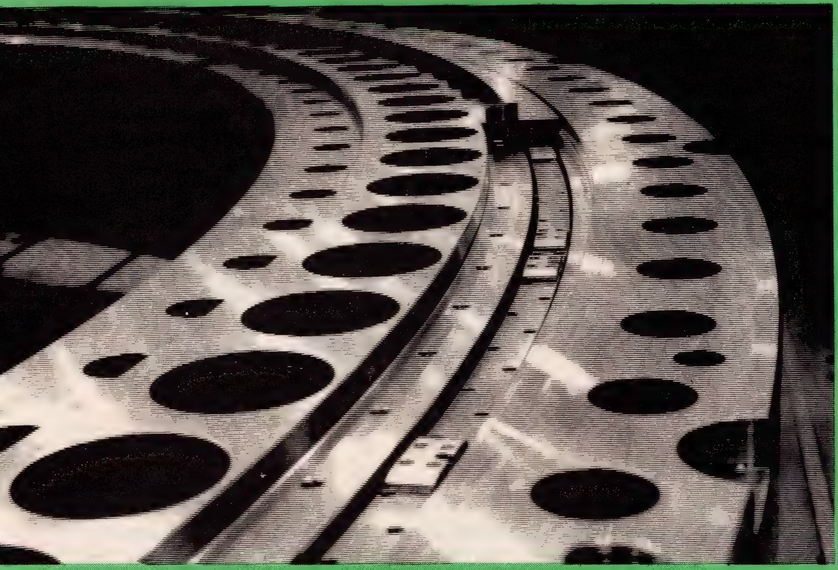
Buzz-saw noise produced by jet engines can be suppressed, if not entirely eliminated, by lining part of the engine duct wall with a porous surface. The combination of porous surface and the chamber above the turbofan blade tip would absorb the shock waves, suppressing the annoying aircraft shrill.



COAL GAS CLEANUP. General Electric has added this special cleanup system for removing more than 90 percent of the sulfur compounds from coal gas produced at its integrated gasification/combined cycle (IGCC) research facility in Schenectady, N.Y. Funded by DOE, it's an adaptation of designs long employed in the chemical process industry. The cleaned fuel gas is burned in combustion facilities that simulate combined-cycle power plant operations.

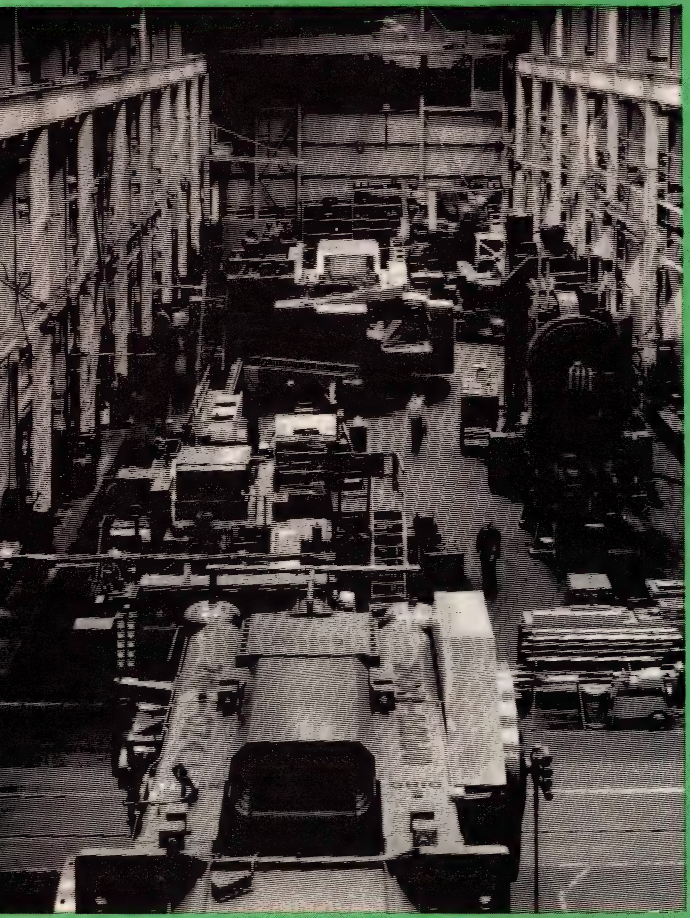
Photo Briefs

Harold Bredin



FUEL ROD TRANSFER at the Clinch River Breeder Reactor Plant is facilitated by this huge Wire-Race™ (inserted raceway) bearing supplied by Rotek, Inc. of Aurora, Ohio. The bearing, specified by Rockwell International's Energy Systems Group, will provide primary support and be the rotating element for a large 40-ft-high (12-m) turntable. The unit indexes rod storage cells into accurate alignment with appropriate transfer ports for the exchange of fuel elements to and from the reactor's ex-vessel storage tank.

TITAN-SIZE WELDMENT POSITIONER weighs 117 tons (106 t), but can manipulate workpieces measuring as large as 12 × 36 × 8 ft (3.7 × 11 × 2.4 m) and weighing up to 175 tons (161 t). Built by Airco Welding Products' Aronson Machine Co. in Arcade, N.Y., this Titan GE3500 Geared Elevation ® positioner has a 14 × 14-ft (4.3 × 4.3-m) rotating, tilting table powered by a 25-hp (19-kW) motor. Elevating power is provided by a 150-brake-hp (112-kW) motor and, fully extended, the Titan measures 20 × 20 × 20 ft (6 × 6 × 6 m).
▼



◀ GIANTS OF INDUSTRY. Some of industry's largest high-production hot- and cold-forging machines and headers are seen here at the heavy machinery assembly bay of National Machinery's Tiffin, Ohio plant. Among them in their temporary home are seen an 8000-ton (70,000-kN) Maxipress (foreground), a 10-3 hot former (center, left) and a 9-in. (23-cm) tong-feed forging machine (right, rear). Others include bolt- makers, nut formers, cold formers, and progressive and high-speed headers.

International Focus

Engineering News and Developments from Abroad

Hanover Fair: A New Concept

West Germany—The Hanover Fair '81, to be held Apr. 1–8, 1981, in Hanover, will now include nine major exhibit categories. Each exhibit category will constitute a major industrial exhibition. The new fair categories follow: Office and Data Technology, Electrical Engineering and Electronics, Power Transmission and Control, Plant Design and Construction, Factory Equipment and Materials, Transport and Traffic, Construction, Subcontracting, and Research and Development.

The idea of including these nine separate exhibitions is to maintain the advantages of the multibranch Hanover Fair while adding the benefits of a highly specialized trade fair. This new concept is intended to provide significant advantages for both exhibitors and visitors:

- Optimum international marketing exposure for all exhibiting firms.
- A more appropriate grouping of exhibits according to major industry categories.
- Easier visitor orientation at Hanover's large fairgrounds through clearly defined and color-coded individual display groups.
- Many different industry groups which visitors can readily select as they suit individuals' interests and requirements.

The traditional Hanover multibranch fair has in the past included almost 30 different display groups, which segregated exhibitor categories by the type of production process used to make a product. The new Hanover Fair will concentrate on the nine new industry sectors. In this arrangement several mutually complementary industries are grouped together. This will provide a more comprehensive presentation of industry technology with its entire scope of equipment, machinery, accessories, and services. Visitors will be able to more easily identify, locate, and review all of the elements in their specific field of interest at one convenient location.

Maximum Demand Controller

Israel—Bitronics Ltd. of Tel Aviv has developed an automatic load programming unit that constantly monitors the rate of energy consumption and compares it against a preset value. The unit, called a maximum demand controller (MDC), limits demand by deferring disconnecting controllable loads in programmed sequence when the rate of consumption exceeds the preset limit.

The MDC also serves as a real forecasting device. The input signal is fed by the watt-hour meter through contact closures or pulses, together with synchronization pulses from the measurement interval of the utility meter. Using a sophisticated analyzer, the MDC continuously processes these input signals, and forecasts the demand throughout the selected measuring interval. The forecasted demand is compared against the manually set demand.

If the estimated forecast demand exceeds the preset demand target, the MDC load control unit is activated and the controlled loads are disconnected individually in sequence. This procedure is subject to a preset priority matrix until balance is reached. The loads are restored automatically after a preset time interval, specific to each load group, has elapsed.

The maximum demand controller is available in two models: the MDC-3, which controls three circuits; and the MDC-8, which controls eight circuits. A full range of special adaptors is also available.

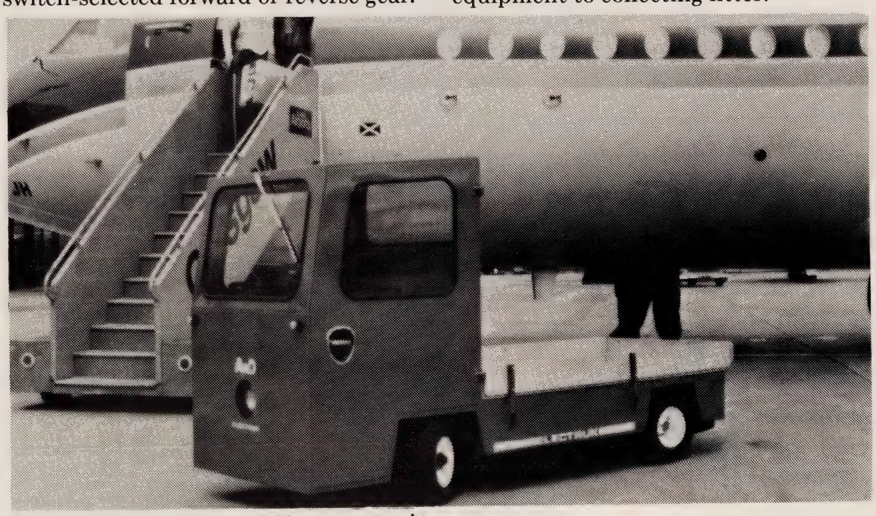
Electric Flatbed Vehicle

Scotland—An electric flatbed vehicle—winner of a 1980 Design Award from Britain's Design Council—has four wheels for stability, but maneuvers in confined spaces almost as well as a three-wheeler, according to the manufacturer, AWD Electric Vehicles, Glasgow.

The Scottish-made Electruk has a turning radius of only 7 ft, 3 in. (2.2 m) and an overall length of 9 ft, 6 in. (2.9 m). Steering is by worm gearbox. The low height of the vehicle's flatbed keeps the center of gravity within safe limits even when the truck is fully laden.

The rear wheels are individually driven by electric motors through reduction gearboxes and chains to the rear axle. Maneuvering is simple, with switch-selected forward or reverse gear. A pedal gives smooth, progressive acceleration through an electronic controller. Hydraulic brakes operate on the rear wheels; the motors are fitted with electromagnetic, fail-safe disk brakes. Simplicity of design and the all-steel chassis and body allow repair work to be carried out with standard metalworking equipment and without expensive spare parts. Routine maintenance is facilitated because the rear platform and driver's seat can be listed for all-around access.

Several versions—e.g., with or without driving cab, for 2200- or 4400-lb (1000- or 2000-kg) capacities—are available, and the battery-operated truck has many uses, ranging from transporting delicate electronic/testing equipment to collecting litter.



Electric flatbed vehicle is highly maneuverable.

Infrared Sensing Device

England—BHRA Fluid Engineering has developed an accurate and inexpensive infrared sensing device for measuring the velocity of a solid body moving through a fluid.

Recently, BHRA needed to record the velocity of a solid body ejected rapidly into a volume of water at varying speeds. The cost of hiring a high-speed camera and other equipment proved to be too expensive, and the time lag between filming the tests and analyzing the developed film was too great from the client's point of view. Inertial transducers mounted on the body had the disadvantages associated with the umbilical cable carrying the signals to the analyzer, while contacting velocity transducers interfered with body motion.

BHRA's solution used the property of selective absorption of an infrared beam by black and white surfaces. The body whose velocity was to be measured was painted with black and white rings, and an infrared transmitter was positioned so that the body passed through its beam. Reflection of the beam from the white areas was sensed by a receiver, which responded with a signal, so that as the ringed body passed through the beam a series of pulses was produced, corresponding to the number of white rings. The pulses were translated into velocity readings, knowing the time separation and ring width. Construction costs were small—only a few pounds—and the client was delighted as BHRA saved him both time and money.

In liquids, the sensor's efficiency can be enhanced by taking infrared signals out of the liquid along optical fibers. Both digital and analog recording instruments can be used with this device, providing results immediately.

Further details of BHRA's contract research and development services can be obtained from Dr. Alan Burns, BHRA Fluid Engineering, Cranfield, Bedford MK43 0AJ, England.

I-F Business Briefs

Swedish Nuclear Fuel Supply Co. has awarded **ASEA-ATOM** a contract valued at $85 million to supply a facility for storing spent nuclear fuel from Swedish nuclear power stations. Designated the Away From Reactor Storage facility, the plant will be designed to store 1500 tons of spent fuel when it opens in 1985. Later, its capacity will be expanded to 3000 tons. The facility is said to be the first of its kind ever ordered anywhere ...... Coal-fired steamships will be returning to the high seas, powered by **Combustion Engineering** marine boilers. C-E's licensee in Italy, **Franco Tosi S.p.A.,** has been awarded the world's first contract in 20 years for two coal-fired boilers by **Italcantieri S.p.A.,** a shipyard in Monfalcone, Italy. The boilers will power two 75,750-dwt bulk carriers being built for Bulkships, Ltd. of Australia, scheduled to be delivered in late 1982 and early 1983. C-E will perform all design engineering and Franco Tosi will manufacture the boilers ...... The **Royal Netherlands Navy** has selected the Sperry division of **Sperry Corp.** to produce two ships' inertial navigation systems for use aboard "Walrus II" class submarines now under construction. Under the award, Sperry will provide the Royal Netherlands Navy with the systems in late 1981. The systems are the first low-cost ship's inertial navigation system purchased by a European NATO nation for application in the NATO forces ...... Construction is under way in Dhahran, Saudi Arabia, for the expansion of **Arabian American Oil Co.'s** (Aramco) international headquarters. Two office buildings, computer facilities, and a landscaped plaza will be built adjacent to Aramco's existing administration building. The new complex is a joint project of the Houston-based **CRS Group, Inc.,** and **Redec Daelim Saudi Arabian Co. Ltd.** ...... **Lawrence Livermore National Laboratory** (LLNL), Livermore, Calif., has awarded a $1.34 million contract to the **English Electric Valve Co., Ltd.,** of Chelmsford, England, to provide 2050 thyratron tubes for the Advanced Test Accelerator (ATA) project. The ATA is a $42 million linear electron beam accelerator for the study of charged particle beam technology. It will be built at LLNL's Site 300 testing area about 18 mi (29 km) southeast of Livermore in the hills between Livermore and Tracy. ATA is funded by the Defense Advanced Research Projects Agency and will be operating in 1982. The DARPA agent is the Naval Surface Weapons Center ...... **Mitsubishi Petrochemical Co., Ltd.,** of Tokyo, and **Mitsubishi Corp.** have agreed to form a new manufacturing and sales company to expand their phenol and acetone operations. The new firm, **Japan Phenol Co., Ltd.,** will have a 100,000-ton phenol and 60,000-ton acetone output annually ...... A large-scale investigation of the world market for electricity generating sets powered by diesel engines is planned by the Marketing Div. of **ERA Technology Ltd.,** of Leatherhead, Surrey, England. Research will cover user countries in the Middle East, Central and South America, Asia, and Africa, concentrating on territories where prospects for such plant are known to be good. Information will also be sought in the main supplier countries of Western Europe, the U.S., and Japan. In addition to an analysis of markets and trends in the base year (1980), the results will include forecasts of orders placed in the years to 1984 and information about the methods of selling, distribution techniques, and stocking policies ...... **The Japanese market for packaging machinery and equipment,** at $733 million in 1978, will increase to $1564 million by 1989 (constant dollars), according to a recently issued, 170-page study by market researchers Frost and Sullivan, Inc., in New York City. Nearly 80 percent of the market is for individual packaging machines, and 20 percent for outer packaging/shipping, the report says. Market share among the five major machine types are: form-fill sealing machines, 27 percent; bottling machines, 22 percent; strapping machines, 18 percent; over-wrapping machines, 17 percent; and filling machines, 16 percent ...... **Zurn Industries, Inc.,** announced that its subsidiary, The Permutit Co., Inc., has received an award for construction and installation of a 1-million- gpd (3.8-million-L/day) seawater desalting plant. The new reverse osmosis facility, valued at over $7 million, is an expansion of an existing Zurn/Permutit 800,000-gpd (3-million-L/day) seawater desalting system now serving CADAFE, the Venezuelan government electric power authority Planto Centro electric power generating station located on the Caribbean Sea at Punta Morón, 120 mi (190 km) west of Caracas ...... **NKK** has recently signed a business agreement with Britain's **Ruston Gas Turbines Ltd.** to sell Ruston gas turbines in the world market. Under the agreement, NKK will conduct package sales of turbines designed and produced by Ruston, including generators and compressors ...... **Combustion Engineering, Inc.** and **Mitsubishi Heavy Industries, Ltd.** (MHI) of Japan are cooperating on a coal gasification study sponsored by a major Japanese utility company. MHI will conduct a feasibility study relating to coal gasification processes, equipment, and economics for a 500–600-MW coal gasification plant. C-E will support MHI's efforts in developing a comprehensive report by supplying technical data and information relating to the C-E coal gasification process.

ME News Roundup

Current Engineering News, Events, and Comments • Joyce Moskowitz

What Do an Office Building, Prison, and University Hall Have in Common?—Energy-Efficient Designs

A simple and inexpensive application of passive solar energy to keep heating costs low for the new Sport-Obermeyer offices in Aspen, Colo., won for the architectural firm of Copland Hagman Yaw Ltd. one of the seven 1980 Energy Conservation Awards presented by Owens-Corning Fiberglas Corp. The complex, which houses a 20,000-sq-ft (1860-m^2) warehouse and a 10,000-sq-ft (930-m^2) office facility, looks just like a conventional building, but uses solar energy as its primary heat source.

The southerly facade of the warehouse is a hybrid, selective-surface, Trombe-type wall measuring 120 ft long by 20 ft high (37 × 6 m). The wall is a passive solar collector made of heavy masonry and glazed on the outside with iron content glass, which permits maximum solar radiation to be transmitted to stainless steel plates — the selective surface.

The architectural and engineering firm of Caudill Rowlett Scott was honored for substantially reducing the need for artificial lighting in its design of Shell Oil Co.'s Exploration and Production Office in Houston, Tex. The electric-powered 828,000-sq-ft (76,900-m^2) building, which will house over 2000 employees, is expected to use 50 percent less energy than the average consumed by energy-efficient buildings in Houston. The major emphasis here was on the reduction of the energy load for lighting, by using available daylight.

Caudill Rowlett Scott won a second award for the design of the Federal Correctional Facility for Youth Offenders in Bastrop, Tex., which will house 500 inmates and support personnel. The new complex uses both passive and active solar systems. A saw-toothed roofline houses 25,000 sq ft (2300 m^2) of solar collectors sloped at an optimum angle. The solar system will provide about 97 percent of the domestic hot water, 45 percent of the heating, and 9 percent of the cooling through an absorption chiller.

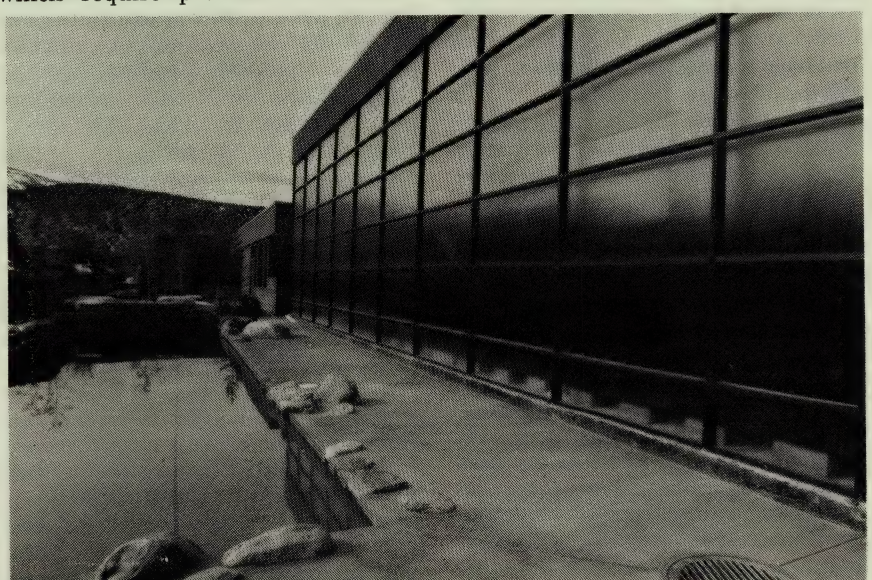
Williamson Hall — an earth-sheltered building at the University of Minnesota, Minneapolis, Minn., was designed by Myers & Bennett Architects (the fourth award winner), to preserve the scarce open space on the campus, and the view of the historic buildings. Approximately 95 percent of the building is depressed into the ground—with the lowest offices about 26 ft (8 m) underground. The complex was put below ground to shelter it from Minnesota's extreme temperature changes. At 20 ft (6 m) down, the soil stays about 50°F (10°C) year round.

During the day the underground building retains heat from people, lights, electric machinery, and the sun. A heat recovery system removes heat from the exhaust air and introduces it into the intake air. To back up the system, a solar energy system with 6000 sq ft (560 m^2) of collectors and an 8000-gal (30,300-L) storage tank is used.

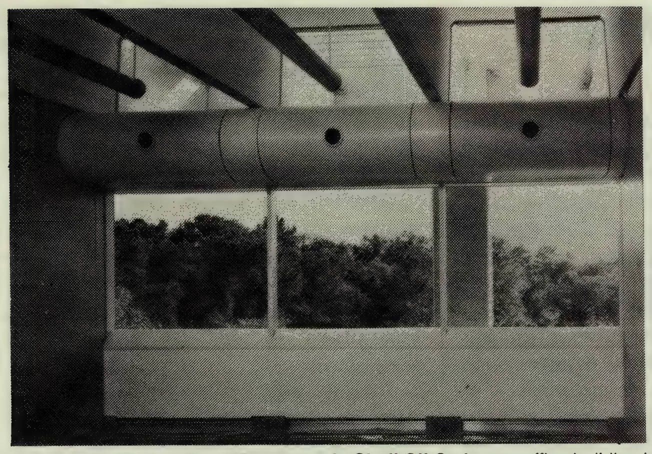
The SmithKline Corporation's Pharmaceutical Research Laboratory in Upper Merion, Pa., a 160,000-sq-ft (14,900-m^2) building which will be completed in 1982, is expected to use approximately 53 percent less energy in terms of Btu's per square foot per year than a conventional structure. The nature of the work performed in the laboratory is the development of new pharmaceutical compounds — which require precise environmental controls. There will be 150 room air changes per hour and, in addition, 70,000 gal (260,000 L) of hot (200°F, or 93°C) water are needed daily to wash the animals' cages.

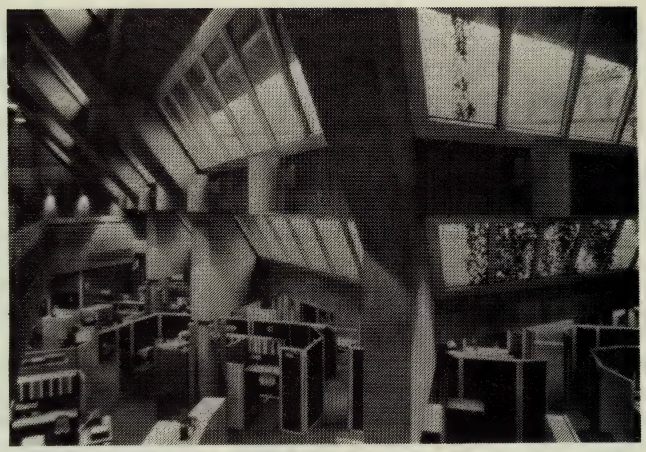
Ballinger Architects and Engineers have been honored for their design of this research lab, which will reclaim heat from process water, and use innovative air-conditioning concepts and an active solar system. The system employs oversized ducts and low face velocity coils, which allow larger volumes of air to pass through the ducts without increasing fan horsepower. High-efficiency air-to-air heat exchangers are used to transfer the energy from the exhaust system to the incoming fresh air system. This allows for preheating or precooling at minimal expense. A heat recovery system also is used to heat water for washing equipment, which accounts for 50 percent of the building's energy use.

The sixth awardee, Cannon Design, Inc., was cited for the plan for Hooker Chemical Co.'s office building in Niagara Falls, N.Y., which calls for an exterior that adjusts automatically to weather conditions to meet the building's lighting, heating, and cooling needs. The building will be completed late in 1981. The exterior consists of



A Trombe-type wall on the southern side of the new Obermeyer Corporate Office complex is made of glass with minimal iron content, allowing more than 90 percent of the incident solar radiation to be absorbed on the selective surface.





Left photo: Most of the office space in Shell Oil Co.'s new office building is in contact with natural light to help save on the amount of energy consumed for artificial lighting. Sixty percent of the offices have an outside view, and the rest look onto an interior landscaped atrium. **Right photo: Twenty-six ft (8 m) underground**—at its lowest point—Williamson Hall at the University of Minnesota houses the school's bookstore and admissions office. The roof of the building consists of sod, concrete, insulation, and rubber membrane waterproofing, and provides a courtyard and landscaped areas. From inside, one can see sunlight and the outdoors from almost anywhere.

an inner glass wall and an outer one, 4 ft (1.2 m) apart. The double skin will reduce the impact of air infiltration. Between the glazed walls are airfoil-shaped louvers. During the day when the building is occupied, the louvers on each face will move simultaneously to track the sun, eliminating the heat gain from direct sun, yet allowing diffuse light into the offices. At night the louvers close completely, creating a fully insulated and opaque shell. The glass skins also serve as solar heating collectors. Temperature-activated sensors control vents in the space between the two glass skins to admit heat into the offices.

The final award winner, the architectural firm of Flatow, Moore, Bryan, & Assocs., was cited for its design of the Willow Creek Office Building in Idaho Falls, Idaho. A heat pump system with thermal storage in water tanks conserves energy in the heating and cooling of the building. High-pressure sodium vapor lighting reduces electricity consumption. The lighting system consumes less than 1 W/sq ft (11 W/m^2), compared to conventional systems that consume from 2 to 4 W/sq ft (22–43 W/m^2).

The internal heat source pump system at Willow Creek obtains heat from the people and lights inside the building, and transfers it to a 200,000-gal (760,000-L) thermal storage tank filled with water. The heat from people and lighting alone can maintain a comfortable office temperature with outside readings down to −6°F (−21°C). Air for cooling is usually derived from the cold water compartment of the storage tank, and circulated with its own fan system. The building is also designed for maximum use of solar light to reduce electricity consumption. A stainless steel sill at each double-pane window that reflects exterior sunlight and bounces it off the ceiling reduces artificial lighting needs by 20 percent around the perimeter of the building. A 5900-sq-ft (548-m^2) skylight in the lobby also helps reduce energy costs.

This year's awards were presented on Dec. 8 in New York City. The Owens-Corning Annual Awards Program is endorsed by the American Institute of Architects, ASHRAE, and the U.S. Department of Energy.

Waste-to-Energy Conversion—Sound, But Costly

With prospects diminishing for finding local sanitary landfill sites, more metropolitan communities will be looking for new methods of disposing of solid waste. Perhaps they can take some tips from Europeans who for many years have been using technically reliable and environmentally acceptable mass burning furnaces to incinerate unprepared municipal solid waste, and to recover energy. According to researchers at Battelle's Columbus Laboratories, Ohio, who studied 15 European refuse-fired steam and hot water generating plants, the U.S. could benefit from developing similar plants. The Battelle study was carried out for the U.S. Environmental Protection Agency's Office of Solid Waste.

At present, some 450 installations worldwide are converting refuse to steam, hot water, and electricity. Of these, more than 300 are in Europe, and only nine are in the U.S.

Europeans have found solid waste to be a difficult fuel, but one that can be used for energy recovery in an environmentally acceptable manner, even when used in residential areas. The waste-to-energy systems are not cheap, however, with an average net cost of \$16/ton. Most European refuse-fired energy systems are, therefore, municipally owned and operated. The plants usually produce by-products of inert ash (which can be used for highway roadbeds), and steel scrap (which can be used for remelting).

Several feasible systems have been demonstrated in Europe, including those for power generation, steam heating, water heating, and thermal sludge drying and burning. One U.S. system produces steam and 41°F (5°C) chilled water for cooling 30 downtown office buildings, a hotel, and a convention center in Nashville, Tenn.

The Stumbling Blocks—Erosion, Corrosion. European low-temperature heating plants usually operate effectively below the boiler tube temperature range (500 to 600°F, or 260–320°C) at which corrosion becomes a problem. Some of the systems, however, especially in the older plants, are experiencing erosion and corrosion problems. Steam temperatures over 750°F (400°C) have often caused severe corrosion and costly maintenance. These higher temperatures are partly a result of the steady rise in heat value of refuse over the years. But there are many other causes of erosion and corrosion, including alternating of reducing and oxidizing atmospheres, high levels of carbon monoxide, high metal temperatures, high combustion gas velocities, high levels of chloride, and excessive steam soot blowing.

Europeans have come up with some effective methods to eliminate the corrosion problems, including silicon carbide coating on furnace wall tubes ex-

posed directly to flames. In addition, they have placed the superheater in remote locations in the second or third boiler pass, thus limiting its exposure to flames or excessive temperatures.

Pollution control is a major factor in plant construction in Europe. The boilers cool the hot, dusty gases to temperatures below 500°F (260°C), making possible the use of electrostatic precipitators. Dust collection efficiency in some plants is often above 99 percent. Germany is particularly strict about regulating such acid-gas emissions as hydrogen chloride, hydrogen fluoride, and sulfur dioxide. Its regulations require new or expanded plants to remove 90 percent or more of these gases from their exhaust.

Mechanics in Action at Toronto IUTAM

More nations than ever before sent engineering scientists to Toronto, Ont., Canada, to participate in the recent week-long 15th International Congress of Theoretical and Applied Mechanics. The congress, which has been held every four years since the 1920s—except during World War II—provides a forum for the free-flowing exchange of information and cooperation across national boundaries.

Over 800 registrants pondered the mystery engendered by ASME's *Applied Mechanics Reviews* exhibit of some 100 mechanics journals, 20 of which started in 1980. The exhibit, entitled "Mechanics in Action," and held at the University of Toronto, brought to light an interesting question: Why is the number of new journals three times higher for 1980 than the average during the last 10 years?

Applied Mechanics Reviews' Russian counterpart, the *Referativny Zhurnal Mekhanika,* was well represented by its editorial staff at the congress, and valuable information was exchanged in meetings and through slide shows.

A token gift, a jumping disk distributed to participants, not only tossed some light relief into the occasion, but in some instances struck a note of intrigue. A contest requiring the partic-

Management Wrinkles...

Management Style

Every manager has a style of managing that reflects his or her basic personality. Some styles have proven more effective when dealing with engineers than others. The autocratic style of management is often seen in engineering managers, the reason being that those engineers who have been successful in their aggressive, self-confident approach to solving problems are usually the ones chosen to be managers. Unfortunately, though, these engineers sometimes fail as managers because their preoccupation with getting the job done results in their neglecting the people they manage.

Engineers usually respond negatively to the autocratic manager, because they believe that his insistence on doing things his way diminishes their freedom to use their own experience and creativity. Younger engineers are particularly resentful of this type of manager because they have been taught in engineering school to believe in teamwork and the benefits of group decision making. Their introduction to the world of design under the tutelage of an autocratic manager can be a traumatic experience. The most likely result is that potentially creative problem-solvers will submerge their own ideas in order to align themselves with the boss's wishes.

At the other end of the spectrum of management styles is the "country-club manager," who tries to avoid conflict within his department by exaggerating the importance of the individual. He becomes preoccupied with achieving a work situation in which all of his subordinates are happy with working conditions and with him as manager. This style of management is usually not productive, because it does not challenge engineers sufficiently with interesting and demanding assignments to give them the feeling that they are contributing to the goals of the department. Country-club managers soon find that their effectiveness as leaders is undermined by anarchy among subordinates.

Management style is directly related to the personality of the manager. Personality is a function of a person's total life experience and cannot be easily changed. Yet sometimes the demands of a job require that a manager adopt a style that conflicts with his personality. This could lead to a stressful situation that is both physically and mentally damaging. For example, a manager whose personality places him in the autocratic category may find it difficult to provide advice and guidance to line supervisors. Similarly, a manager who tends to be easygoing may be out of his element in managing an operation that must produce a continually high output.

To be effective, each manager must understand the requirements of his job and determine the management style that will best suit those requirements. Although personality characteristics cannot be changed easily, understanding the relationship between job-required style and personality can alleviate much of the stress caused by a mismatch.

The Ideal Manager. The ideal manager has to be all things to all people in order to satisfy the requirements of his or her superior as well as the needs of subordinates.

From the superior's viewpoint, the ideal manager has to have considerable "horse sense," or practical knowledge, on how to get the job done. Certainly, he has to be profit-oriented, since increased productivity and reduced costs are key management goals.

Recognizing the importance of concern for people, a superior also expects the ideal manager to be human-relations-oriented. This requires not only the skills that can be obtained through formal education or training, but also an orientation toward people and their development that can come only from the manager himself. Finally, the ideal manager has to be both a fluent speaker and writer, so that he can keep his subordinates, clients, and superior informed about the activities of his department.

From the engineer's point of view, the ideal manager must first of all be competent in engineering. Engineers expect their managers to come from their own ranks, and they expect them to have done work similar to that being done in their own group. Most engineers look up to their managers as technical experts. This poses a difficulty for managers today because technology is changing so rapidly that only technical

ipants to describe the disk in as many words as possible was well under way when a certain Dr. W. H. Wittrick from England casually revealed that he had written about the theory of the jumping disk in the *Quarterly Journal of Mechanics and Applied Mathematics* in the early 50s. He had to be hushed up.

On a more formal note, officers for the International Union of Theoretical and Applied Mechanics were elected: Daniel C. Drucker, dean of the University of Illinois' College of Engineering in Urbana and past president of ASME, was elected president of the Union for the next four years.

The next congress will be held in Denmark in 1984.

specialists can effectively stay up to date. At a minimum, engineering managers must be familiar with the terminology and basics of the disciplines they manage in order to effectively communicate with their subordinates.

Finally, engineers expect their managers to be respected by their peers and by top management. Engineers rightly believe that such respect is necessary if a manager is going to have enough influence in an organization to get things done.

These qualifications are not all acquired through experience. Some are inherent in a manager's personality and cannot easily be developed if they do not already exist. Other qualifications can be developed through training and other self-development techniques.

The effective engineering manager is able to mesh all these ideal traits with his or her own aspirations for success. He sees that the development of people and the consequent increase in productivity are the keys to getting his job done and will reflect favorably on his performance as a manager. Thus, he does not feel threatened by capable and aggressive subordinates because he realizes that his record and future will be enhanced by their behavior.

Managers get things done through other people. The better the job that a manager's subordinates do, the more esteemed the manager will be in the eyes of both his subordinates and his peers. — *Ed Repic, Downey, Calif., Mem. ASME.*

NSF Plans Shift from Basic Science to Engineering

The National Science Foundation, which was originally created to support basic research (in physics, chemistry, biology, etc.) will soon be putting stronger emphasis on engineering and applied science.

Continued and growing pressure from Congress, industry, the engineering profession, and now the incoming Reagan Administration, for more practical research which will boost industrial growth, is what forced the science agency to reexamine its role. The agency has long been considered one which backed fundamental inquiry, and not quick practical dividends. And there is sure to be uneasiness among the nation's academic scientists over this shift.

"The engineering societies have strongly proclaimed the need for improved support to engineering research and the NSF unquestionably has to deal with that," said Dr. John B. Slaughter, the agency's new director. Slaughter said that there would be "strong emphasis" on engineering and technology at the agency, which annually distributes \$1 billion/yr for research and education. He hopes, however, that this can be done by finding new funds rather than diverting them from other research.

Slaughter, who is an engineer by training, and was provost at Washington State University, Pullman, Wash., until his new appointment, spoke in front of a small group of leading scientists who met in Washington in November at an annual meeting of the Council of Scientific Society Presidents. (See the Washington Window in the December issue of ME, p.77.)

Air Pollution Control Symposium

The purpose of the Air Pollution Control Symposium is to discuss emission controls as integral components of conventional coal-fired plants and to optimize the total aggregation of power plant and environmental controls as a complete system. There will also be a look at advanced technologies in this field. The 1981 Air Pollution Control Symposium is being sponsored by the Air Pollution Control, Fuels, and Power Divisions of ASME, the Electric Power Research Institute (EPRI), and the Air Pollution Control Association. It will be held on Feb. 22–25, 1981, at the Stouffer's Denver Inn, Denver, Colo.

In addition to technical sessions, there will be two luncheons, and a tour of the EPRI Arapahoe Test Facility, including the Integrated Emission Control Pilot Plant. Also, on Feb. 21–22, there will be a course on air pollution control equipment specifications.

For further information contact: Angela Cheung at ASME headquarters, (212) 644-7795.

Wear of Materials Conference in San Francisco

The Third International Conference on Wear of Materials is to be held at the Sheraton Palace Hotel, San Francisco, Calif., Mar. 30 to Apr. 2, 1981. This conference is being cosponsored by ASME and the Japanese Society of Lubrication Engineers, and also supported by ASTM, AIME, ASM, the American Ceramic Society, and SPE. This conference will include sessions on wear of metals, wear of polymers, fretting, abrasion, erosion, wear of tools, coatings, and composites, and wear of lubricated systems, and also a workshop on new directions in wear theory as well as a review session. A total of 100 papers from 15 different countries will be presented.

For more information, contact Dr. S. K. Rhee, Conference Chairman, Bendix Corp., Southfield, Mich. 48037, (313) 827-5766; or Dr. A. W. Ruff, Program Chairman, National Bureau of Standards, Washington, D.C. 20234, (301) 921-2966.

R&M Symposium to Explore Productivity Improvement

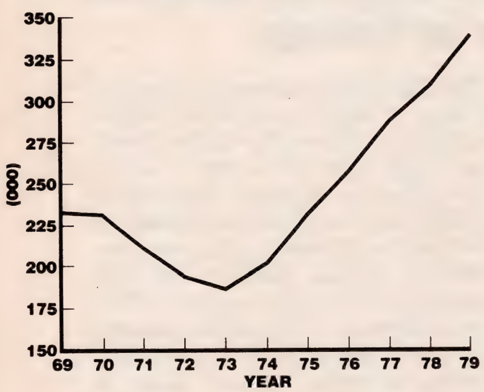
The 27th Annual Reliability and Maintainability Symposium, cosponsored by nine engineering societies, including ASME, will take place Jan. 27–29, 1981, at the Marriott Motor Hotel in Philadelphia. In addition to technical sessions, there will be policy and management sessions by top government and industry leaders. The keynote speaker will be General John R. Guthrie, U.S. Army Material Development and Readiness Command. A series of tutorial sessions on basic elements will be held for engineers who wish to develop a background in the fundamentals of R&M.

On Jan. 29 ASME members will meet to discuss mutual problems, and to document the main needs of R&M design engineers on design control techniques. For further information, contact: L. D. Connell, at (412) 833-5208.

Education News

Short Courses, Continuation Services, Conferences • Elizabeth Calvelli

Report Shows Decline in Quality of Engineering Education



Total undergraduate engineering enrollment is straining the system's ability to produce quality.

Engineering education in the U.S. is in crisis: It is starting to suffer a decline in quality at a time when the need for highly qualified engineers is critical.

Undergraduate students could be getting a second-class education because of a shortage of teachers, obsolete facilities, and a burgeoning enrollment. In addition, the number of students earning advanced engineering degrees falls short of what the country will need to fulfill its high-technology requirements.

A report on the causes of these problems and possible solutions has been submitted to the Carter Administration by the American Association of Engineering Societies. AAES represents 40 professional engineering groups with nearly one million members. The report, co-authored by the AAES and the American Society of Engineering Education, shows a country eating its technological seed corn, a country letting its innovation—its priceless Yankee ingenuity—dissipate.

The largest factor in the decline in quality is the shortage of engineering teachers. About 2000 of the 25,000 engineering teaching jobs in the U.S. remain empty because typical teacher salaries can be as little as two-thirds of those earned by engineers in industry.

Adding to the shortage is the declining percentage of students going on to earn M.S. or Ph.D. degrees. From 1970 to 1980, the number of masters and professional degrees awarded grew about 11 percent—from 15,548 to 17,243. The number of doctorates awarded declined about 24 percent—to 2751 from 3640. Undergraduate enrollments, by comparison, increased about 47 percent—from 231,730 to 340,488 students.

Aggravating the shortage of advanced degree candidates is the percentage of foreign students in the programs. More than 35 percent of doctoral engineering degrees granted in 1980 and almost 26 percent of the masters degrees granted went to non-U.S. citizens. These degree-holders cannot be counted as a resource of the U.S., because by law, they must return home after completing their studies. Also, while they are in school, many of them cannot contribute significantly to undergraduate education as graders or recitation leaders, because of unfamiliarity with Western industrial culture and deficiencies in English.

To help correct the shortage of teachers, the AAES report recommends giving priority to recruiting and developing faculty. There is an immediate need, it says, to establish 2000 two-year fellowships, funded at $10,000/yr. Such fellowships, restricted to U.S. citizens, would provide graduate assistants to faculty, who would, upon graduation, become candidates for faculty positions. Also, salaries for career professors should be made competitive with salaries in industry, the report recommends.

Obsolete Facilities. As to facilities, the report finds most engineering teaching equipment dates from the 1950s and is outdated. Equipment for growth technologies, such as robotics, microelectronics, and acoustics, is almost nonexistent. Classrooms, too, are aged.

Updating teaching equipment and modernizing classrooms and buildings suffering from deferred maintenance programs will help improve the quality of engineering education, the report recommends. The estimated annual cost is $40 million.

When it comes to undergraduate enrollment—now at 340,000 students (see graph) the report says the 1979 freshman class of more than 100,000 exceeds the system's capacity to educate effectively. The report recommends additional teachers and modern facilities to ensure the system's capacity to provide quality education.

The quality of engineering education, the report concludes, should be of concern to industry and government, because the general health of engineering education is fundamental to the general health of the national economy.

Solar Scholarship

The Solar Energy Industries Association has announced plans for the Sheldon H. Butt Scholarship, to be awarded to students interested in pursuing careers in the solar industry.

SEIA honored Butt with the scholarship—hailed as the only permanent scholarship of its kind—because of his six dedicated years as SEIA president. Since starting the Association in 1974, Butt has helped pioneer and attain SEIA warranty guidelines for solar equipment manufacturers and solar provisions in the National Energy Act. Presently, he is director of market research for the Brass Group of Olin Corp.

SEIA plans to raise $25,000 for the scholarship. Interest from that figure will go to qualified students.

For further information, contact: Solar Energy Industries Assoc., 1001 Connecticut Ave. NW, Suite 800, Washington, D.C. 20036.

NSF Awards Joint Research Grant

The National Science Foundation has awarded a $300,000 joint research grant to Northwestern University and the Inland Steel Co. to fund a study of surface conditions on fatigue crack initiation in iron and steel.

The three-year grant was made through NSF's Industry-University Program. The program was formed to foster basic research in areas of current interest to industry. This is the first grant Northwestern has obtained under this new program.

NU Vice President of Research and Dean of Science David Mintzer, Mem. ASME, called the grant "a welcome opportunity to work directly with industry on basic research."

Principal investigators at Northwestern will be Yip-Wah Chung, assistant professor of materials science and engineering, and Morris E. Fine, Walter P. Murphy Professor of Materials Science and associate dean of graduate studies and research at NU's Technological Institute.

According to Chung, 90 percent of internal failure in iron and steel is due to fatigue. Previous studies have indicated that the fatigue properties of iron and

steels depend strongly on their surface conditions.

"The joint research grant is particularly important because the project requires expertise in many areas," said Chung. "Materials scientists at Northwestern have been studying fatigue in metals for many years and with the assistance in electron spectroscopy and microscopy that can be provided by the scientists at Inland Steel, we are confident that our work will result in the preparation of more fatigue-resistant metals," he said.

Engineering Enrollment Sets New Records

Enrollment in engineering courses at Dartmouth College's Thayer School of Engineering has reached an all-time high and is still climbing. More and more, both graduate and undergraduate Dartmouth students are selecting engineering as a career, or finding it desirable to develop an engineering background to complement other planned careers.

According to Thayer School dean, Dr. Carl Long, the growth of Thayer School reflects a nationwide trend. In that trend Long sees what may be "the beginnings of a modest crisis in engineering education." He wonders, he says, whether in the near future more students may seek to enroll in engineering schools than those schools can accommodate.

For its part, Thayer School is now in the process of hiring four additional faculty members. The school, traditionally small, has also had to move some of its classes to larger facilities elsewhere on campus. Yet there is no air of crisis at Thayer School. School officials make no secret of the fact that the rise in engineering interest at Dartmouth is a welcome happening.

According to Margaret Burg, registrar and graduate admissions officer at Thayer, the engineering school's graduate student enrollment this year topped 100 for the first time. The total of graduate students at Thayer is currently 102, up 54 percent from the 66 enrolled there in advanced degree programs only three years ago. The pattern is similar for Dartmouth's undergraduate department of engineering sciences, also conducted at Thayer School.

For those aiming at careers in engineering, Long said that demand and salary schedules are the strongest attractions.

"There is an increasingly high demand for engineering graduates," he explained, noting also that the starting salaries for engineers has kept pace with inflation better than most other careers.

Students with bachelor's degrees in engineering, he said, can expect starting salaries in the $22,00–$23,000/yr range. Students holding master's degrees in engineering can expect to start their careers making an additional $3000.

"The number of companies recruiting engineers exceeded the number of engineering graduates by 50 percent last year," he said. "Moreover, most students looking for a job in engineering received two or three offers, if not more."

Long added, "Most indications are that no decrease in demand for engineers is indicated over the next five years. Three major U.S. companies alone want 3000 electrical engineers right now."

Long also noted that an increased number of Dartmouth students with majors in fields other than engineering are signing up for engineering courses.

He said, "They are aware that persons with some sound technology background are attractive to many branches of industry. In sales, for instance, product lines require more and more people who can describe complex products."

Increasing numbers of students interested in law careers need some engineering background because so much litigation today deals with complex environmental and technological issues, Long added.

Long emphasized that "the big change at Dartmouth is really in the number of men and women who come here specifically to study engineering. More and more students like Dartmouth's combination of engineering and humanities and they come committed to engineering and they stay committed."

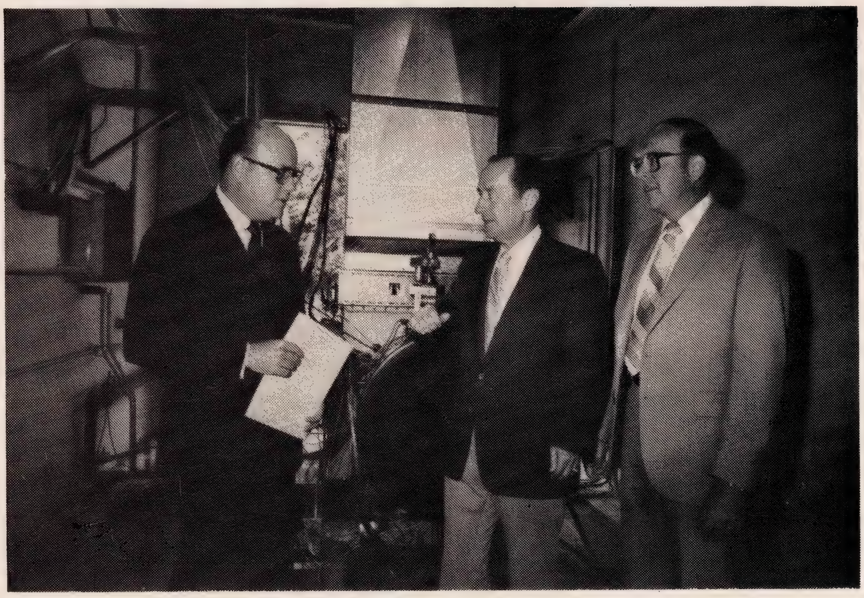
Burg noted that an increasing number of students who majored in fields other than engineering as undergraduates are turning to engineering schools for graduate study. She cited especially the many mathematics and physics majors who are opting for graduate work in engineering.

The Bumpy Ride Study

What combination of rough road and vehicle design makes a drive too bumpy for an average person in a car, truck, or train? The answer varies with season, sex, and individual mood, say Pennsylvania State University engineers who have created the world's first "mechanical man" to substitute for the people traditionally used to measure ride quality or comfort.

Using a steel and aluminum con-

Supporting Engineering Research



A supporter of gas turbine engine research conducted by Virginia Tech's Department of Mechanical Engineering, The Pratt & Whitney Aircraft Group provides additional funds for the continuation of one of the department's existing projects on gas turbines and turbomachinery. Making the presentation of a $3000 check was John Gray, a '65 M.E. graduate, left, and an engineering administrative representative at Pratt & Whitney's West Palm Beach, Fla., facility. J. B. Jones, center, head of the M.E. department, and Walter O'Brien, Jr., right, professor of M.E., received the check.

traption, meticulously designed to simulate the mass, weight, and motion—but not the appearance—of a 170-lb (77-kg) "average" man seated in a vehicle, the researchers have devised an objective standard for measuring how much a person is shaken up by a given combination of vehicle, speed, and road surface.

Along the way, a team led by Dr. James C. Wambold, Mem. ASME, associate professor of mechanical engineering, has gained insight into factors that make for a comfortable ride.

"Thus far," says Wambold, "we've learned that rough rides are better endured in good weather—presumably because bodies are then more limber; and that women's bodies don't resonate as readily as do men's at two critical and annoying side-to-side vibration frequencies—possibly due to women's less rigid hip structure. Also, we've confirmed other researchers' findings that passenger mood affects perceived ride comfort.

"In trying to answer a question first raised during World War II, when many military personnel were badly injured in wartime vehicles, we've designed a dummy. Basically, it mimics the response of a human body to a range of vibrations known to cause discomfort to someone seated in a vehicle that's traveling over fairly rough road at sufficient speed."

The device, Wambold continues, is providing the first assessment of ride comfort—how the body responds to vibrational energy—that eliminates such variables as season, sex, and mood. It works by measuring "seat acceleration": how much the seat moves vertically due to a given level of vibration.

When the dummy had been adjusted to match the physical characteristics of a male student whose weight and physique represented the average man, the dummy was placed in a special seat in a two-passenger motor home.

Alongside sat the student who, during several weeks, drove the vehicle, at different speeds, over a variety of road surfaces, from very smooth to very rough. Instruments recorded the student's and the dummy's responses to vibration.

It was found that comparing such body reactions as stiffness or springiness and "damping," a material's ability to absorb and diminish motion, the device provided a far more detailed, exact, and standardized portrait of ride quality than did the average man.

"For example," explains Wambold, "not only did the dummy eliminate variables due to human influences, but it allowed us to pinpoint precisely what the motion was doing, and to trace a problem's source.

"Thus, we learned that the dummy can answer questions no human can, such as exactly what was wrong with the ride; what characteristics should be changed; is ride quality good but deteriorating; and, if so, how soon will it be objectionable?"

Though the U.S. Department of Transportation originally financed the design and construction of the dummy to gain information about vehicle motion in autos, the project is now being expanded. With funding from the Association of American Railroads, Wambold's team has just completed another dummy, one that can measure both vertical and side-to-side motion.

For, just as the effects of vertical motion must be understood to develop ride quality standards for autos and road surfaces, swaying motion must be analyzed to make train rides less physically punishing for the people most affected—train engineers.

Computer-Aided Design

Candidates for degrees in industrial technology at Western Illinois University are designing mechanical parts with the aid of a computer graphics system as part of their regular classroom assignments.

The objective of this program is to prepare students for careers in production management, according to Dr. Wendell Swanson, chairman of the university's Industrial Education and Technology Department.

The graphics system used by the university, which was leased from McDonnell Douglas Automation Co., (MCAUTO) as a turnkey operation, includes a Data General Eclipse computer, a Tektronix 4014 graphics display terminal, magnetic disk and tape units, and MCAUTO's own computer-aided design and manufacturing system, called Unigraphics. This system, with variations in hardware, is installed in manufacturing companies throughout the world, assuring Western Illinois students that their newly acquired design skills can be applied directly to jobs after graduation.

Swanson said that the students are given assignments to design mechanical parts, such as sprocket wheels and gears, using the Tektronix terminal as a work station. The terminal is used by students 16 hours a day, seven days a week, Swanson reported, requiring students to sign up in advance for a one-hour session with the computer.

Courses in numerical control manufacturing were introduced to the Western Illinois curriculum in 1967 and were staple subjects for the following 10 years. But technology outgrew the curriculum, and it became obvious to the faculty that the students were not being groomed for the real world they would face after graduation.

The introduction of Unigraphics last year has brought the school up to date, according to Swanson, and is even giving Western Illinois graduates an edge in getting the best jobs in industry.

"Unigraphics stimulates our students," Swanson said, "allowing them to solve design problems faster and more accurately then ever before."

Swanson believes that as more businesses automate their design and manufacturing shops, demand will increase for qualified production managers with computer graphics experience.

1981 REGIONAL STUDENT CONFERENCES

Region	Dates	Conference	Location
VIII	May 8–9	Rocky Mt. North	University of Portland
III	April 3–4	Mid Atlantic	University of Pennsylvania
IV	April 3–4	Dixie	Duke University
V	April 3–4	Great Lakes	Ohio State University
VI	April 3–4	Central	Valparaiso University
VII	April 3–4	Northern Plains	N.D. State University
VII & X	April 3–4	(MOAK)	U. of Mo-Columbia/Ks City
VIII	April 3–4	Rocky Mt. South	Utah State University
X	April 3–4	International SW	Texas A&I University
XI	April 3–4	Southeastern	Mississippi State University
II	April 7	Hudson	Pratt Institute
IX	April 24–25	Pacific Northern	University of Nevada-Reno
I	April 25	New England	University of Rhode Island
IX	May 1–2	Pacific Southern	University of Arizona

1981 REGIONAL ADMINISTRATIVE CONFERENCES

Region	Dates	Location
I	March 20–21	Waterbury, Conn.
II	March 27–28	To be determined
III	May 7–9	Allentown, Pa.
*IV	April 2–4	Durham, N.C.
V	April 26–28	Pittsburgh, Pa.
*VI	April 3–4	Valparaiso, Ind.
VII	May 1–2	Minneapolis, Minn.
VIII	May 1–2	Albuquerque, N.M.
IX	May 8–9	Mt. Diablo, Calif.
X	April 26–28	Mexico City, Mexico
*XI	April 3–4	Jackson, Miss.

* Joint with RSC.

Continuing Education Calendar

Increasing Materials Handling Productivity

Place: San Diego, Calif.; Winston-Salem, N.C.
Objective: Seminar dealing with conveyor alternatives, facility layout, storage systems, robotics, and automatic guided vehicles.
Dates: February 2–4, San Diego; March 2–4, Winston-Salem.
Contact: Conference Dept., AIIE, 25 Technology Park, Atlanta, Norcross, Ga. 30092

Solar Photovoltaic Technology

Place: Georgia Institute of Technology
Objective: This course will provide up-to-date knowledge of photovoltaic fundamentals, current devices, R&D programs and future directions for photovoltaics, practical systems design aspects, photovoltaic applications, and economic analysis of practical photovoltaic systems.
Dates: February 23–24
Contact: Continuing Education Dept., Georgia Institute of Technology, Atlanta, Ga. 30332. Tel.: (404) 894-2400

Introduction to Pulping Technology

Place: Chicago, Ill.
Objective: Major pulping and bleaching processes will be reviewed. Several typical pulp mill operating problems will be discussed to illustrate process principles.
Dates: March 5–6
Contact: Janet Crane, TAPPI, One Dunwoody Park, Atlanta, Ga. 30338. Tel.: (404) 394-6130

Heat Pipe Fundamentals and Applications

Place: Washington, D.C.
Objective: For those who need a better understanding of the fundamentals of heat pipes and their applications to various heat transfer problems.
Dates: February 11–13
Contact: Continuing Engineering Education, George Washington University, Washington D.C. 20052. Tel.: (800) 424-9773.

Shale Oil: Its Production, Properties, and Utilization

Place: Colorado School of Mines
Objective: Write for details.
Dates: Feb. 23–26; June 1–4
Contact: Dr. P. F. Dickson, Colorado School of Mines, Golden, Colo. 80401. Tel.: (303) 279-0300.

Brazing Technology—Updating a Fundamental Joining Process

Place: Metals Park, Ohio
Objective: To cover in detail practical methods and applications of brazing technology.
Dates: February 17–19
Contact: Education Dept., American Society for Metals, Metals Park, Ohio. 44073. Tel.: (216) 338-5151

Japanese Methods for Productivity and Quality

Place: San Diego, Calif.; Washington, D.C.
Objective: To present proven innovative methods for the improvement of accuracy and uniformity of production, improvement of service, and increase in output, all with reduced cost.
Dates: Feb. 3–6, San Diego.; March 16–19, Washington.
Contact: Director, Continuing Engineering Education Program, George Washington University, Washington, D.C. 20052. Tel.: (202) 676-6106. Toll-free (800) 424-9773.

Value Engineering

Place: Birmingham, Ala.
Objective: To introduce the unique methods of value engineering/value management, with demonstrations on how to reduce design and construction costs. Selection of value engineering projects, life-cycle costing, and FAST (functional analysis system techniques) will be shown.
Dates: March 16–20
Contact: Auburn University, Birmingham Office-Engineering Extension Service, 85 Bagby Drive, Suite 100, Birmingham, Ala. 35209, (205) 942-7900.

Introduction to Optimal Design

Place: University of Arizona
Objective: To provide engineering designers with an understanding of the optimal design process and exposure to necessary theoretical concepts, to demonstrate application with specific engineering examples, and to give intensive comparative results that allow a designer to choose a particular code implementation.
Dates: March 16–20
Contact: Special Professional Education, College of Engineering, University of Arizona, Tucson, Ariz. 85721. Tel.: (602) 626-3054

Rotor Dynamics Engineering

Place: Daytona Beach, Fla.
Objective: An understanding of the principles of rotor dynamics and the application of these principles to practical problems in rotor dynamics engineering.
Dates: February 16–18
Contact: Graduate Studies and Continuing Education, Union College, Wells House, 1 Union Ave., Schenectady, N.Y. 12308. Tel.: (518) 370-6172.

Plant Layout and Piping Design

Place: University of Wisconsin-Ext.
Objective: This seminar will present the principles of effective piping design beginning with the initial stages of plant layout through piping stress analysis and the production of computerized isometric piping drawings. The use of scale models will be demonstrated as a powerful tool for use in the layout stages.
Dates: February 26–27
Contact: John M. Leaman, Dept. of Engineering and Applied Science, University of Wisconsin-Ext., 929 N. Sixth St., Milwaukee, Wis. 53203. Tel.: (414) 224-4189

Product Development: An Entrepreneurial Perspective

Place: Georgia Institute of Technology
Objective: This course is designed to aid participants in developing strategic criteria for innovative high-technology product development, and to expose them to a screening process for identification, investigation, and evaluation of new product ideas.
Dates: March 23–24
Contact: Continuing Education Dept., Georgia Institute of Technology, Atlanta, Ga. 30332. Tel.: (404) 894-2400.

ASME COURSES

The following courses will be offered at the 26th International Gas Turbine Conference and Exhibit in Houston, Tex., on Mar. 8, 1981:

- **Compact Heat Exchangers**
- **Blade Design Development and Field Experience**
- **Foundations of Axial Turbomachinery Aerodynamics**
- **Introduction to Gas Turbines**
- **Turbomachinery Erosion and Performance Deterioration**
- **Preliminary Design and Off-Design Analysis of Aircraft Gas Turbine Engines**

The following short courses will be offered in conjunction with the ASME-EPRI-APCA symposium in Denver, Colo.:

- **Air Pollution Control Equipment Specifications**
  Dates: February 21–22
- **Permits Under the Clear Air Act**
  Date: February 25
- **Hands-On Operation of Air Pollution Control Equipment**
  Dates: February 25–26

The following short course will be offered in Houston, Tex., February 23–26:

- **Quality Assurance for Nuclear Power Plant Components: ASME Boiler & Pressure Vessel Code—Section III, Div. 1 and 2**

For further information on the above courses, contact: ASME, Professional Development Dept., APC, 345 E. 47th St., New York, N.Y. 10017. Tel.: (212) 644-7743.

Washington Window

Mitchell H. Bradley • Martha H. Frangiadakis • Henry L. D. Ebert

What Will the New Year Bring?

The song they are singing in Washington these days is "there'll be some changes made." Many predicted the Reagan victory last month, but no one—or almost no one—expected the Republicans to gain a majority in the Senate and pick up 33 seats in the House. The one-two punch that the electorate gave the Democratic party could spell the biggest political change since the New Deal.

One of the few who predicted the Senate switch was the new majority leader, Senator Howard Baker (R.-Tenn.). Prior to the election he requested from Senator Harry Byrd the rug measurements of the majority leader's office. Besides getting new carpeting, Senator Baker will have to preside over the Senate's reorganization. This is the first time since 1954 that the Republicans will be the majority party. The transition is going to take time and will not happen smoothly. As the minority party, most Republican Senators have had to be content to act as the gadfly to the majority. Now they must instigate a legislative package—a big change in roles. Many of the "biggies" won't be back for the 97th Senate: Warren Magnuson (D.-Wash.), president pro tempore of the Senate; Frank Church (D.-Idaho); George McGovern (D.-S.D.); Birch Bayh (D.-Ind.); and Jacob Javits (R.-N.Y.); to name a few.

Although Democrats have retained control of the House, they lost 33 seats to the Republican party. Many of the Democrats elected are singing a much more conservative tune.

Musical Chairs. With everyone on the Hill looking for a job, the Congressional staff situation resembles a giant game of musical chairs. Most Senate majority staffers will stay on the Hill, but on different committees. We're all waiting to see familiar faces in different places.

As for the members of Congress, there are some changes there too. We lost some good friends in this election, but hopefully we'll make a few more. Congressman Mike McCormack (D.-Wash.) will not be in the 97th Congress. This is a great loss. Mike not only championed a rational energy policy (and long before it was the thing to do), he acted as teacher to the other members, using his ability to translate technical questions into English during floor debates. Congressman Don Ritter (R.-Pa.), a metallurgical engineer, won reelection quite handily, though. In addition, two more engineers will be freshmen in the 97th Congress: Cooper Evans (R.-Iowa), a civil engineer; and chemical engineer Jim Coyne (R.-Pa.).

How Long Will the Honeymoon Last? The Republicans have received that rarest of all political prizes—an impressive mandate. What they are able to do with this is another story. We are writing this in early December—deep in the "honeymoon" period. Pundits are busy speculating on who will take Cabinet posts in Reagan's Administration. There is a sense of enthusiasm and good feeling that usually accompanies the first blush of change. But the actual tackling of our nation's problems isn't going to happen overnight.

Conservative forces now have the political ability to get some of their views enacted, and the nation will wait to see if they work. But the problems of inflation and economic dislocation aren't going to succumb to any panacea.

Predictions. It is hard at this point to say what the Reagan Administration will do. Until his Cabinet appointments are made and things are a bit shaken down, what he has in mind for domestic and international programs will still be a matter of speculation. Hard questions aren't asked on honeymoons. We can safely predict a few things he won't be able to do, however. There has been much talk about the dismantling of the Departments of Energy and Education, and the newly created Synfuels Corporation. These are not going to go away quickly, if at all. They each have legitimate functions and carry out laws enacted by Congress. Congress would have to preside over their dissolution, and it would be a long and bloody battle. We expect that the Reagan Administration will implement many of the regulatory reforms started by Presidents Ford and Carter—but with even more vigor. We expect not only to see changes in the top management of EPA and OSHA, but in the second and third tiers of management as well. Reagan wants to bring people to Washington who are capable and who have hands-on experience. One pundit said that anyone who doesn't have to take a 50-percent pay cut to come to Washington need not apply.

The next year will be a busy one for the Congress as well. The Clean Air Act is up for review next year. The direction it will take now is anyone's guess. Senator Stafford (R.-Vt.) will be the new Environment Committee chairman. He is a moderate and has the reputation of working well with the majority when he was ranking minority member. He will fight the butchering of the legislation.

We expect to see more energy legislation featuring tax benefits and other incentives for production. The windfall profits tax will most likely stand.

We hope to make this a year for engineering education. The fact that engineering faculty (or lack thereof) has reached crisis proportions has resulted in quite a bit of media attention. Hopefully, this can be translated into legislative action in the coming Congress.

The more conservative viewpoints on issues like materials stockpiling and taxation for U.S. citizens working overseas—many of whom are engineers—should prevail. Expect to see legislation passed that encourages our ability to compete in world markets and improve our economic status. Programs that tend to cost big money and offer little feedback, on the other hand, will suffer. What bearing these changes will have on the condition of the country remains to be seen. We will—as ever—keep you posted.

Congressional Fellowships

Applications are being accepted for the 1982 Congressional Fellowship program. For the ninth year, ASME will sponsor two mid-career engineers to come to Washington for a year and work on a Congressional staff. ASME Fellows have served on committees and helped write legislation covering such areas as energy, metric conversion, nuclear waste, and budget authorizations. For further information and applications, write: Mitchell Bradley, Federal Government Relations Office, 2029 K St. N.W., Washington D.C. 20006.

Socio-Technical View

Sponsored by the Technology & Society Division

Should Government Control Exports of Unsafe Products?

Should the U.S. government ban the export of products and materials manufactured in this country that have been declared unsafe for domestic use? This question has been receiving a lot of attention during the past few years, both in Washington and in the offices of a number of our major industries, especially chemicals, pharmaceuticals, fertilizers, and pesticides. Of specific concern is the legal and knowing exportation of a product or substance of questionable safety to a developing country that does not have any regulations referring to the importation or safe use of that dangerous material. For three years a federal task force has been wrestling with this question and has recently issued the fourth revision of a draft report of its recommendations.

The Case For Stricter Controls. Those proposing stricter export controls, such as the Public Advocates, which represents 17 civil rights and human rights organizations, cite a number of past bad situations to back their arguments. The best known, and the one instigating most of the recent action, is the TRIS children's sleepware case. After TRIS, a fire-retardant, was shown to cause kidney cancer in children, sale of TRIS-treated pajamas was banned in the U.S., in 1977. However, sales continued abroad for almost a year, and about 2.4 million pieces were sold abroad and presumably worn by foreign children. The Consumer Product Safety Commission specifically banned the export of these products in June 1978.

Another problem has been pesticides. Nearly one-third of the billions of pounds of pesticides exported in the late 1970s were never registered or approved for use in the U.S. The most infamous case involves a substance called leptohos, never approved for sale in this country. Between 1971 and 1976 nearly 14 million lb (6.4 million kg) of leptohos were exported to 50 countries. It has since been linked to the death of more than 1000 water buffalo in Egypt, and to speech and vision problems and possibly deaths of some farmers in that country.

Against Stricter Controls. Although they agree that situations such as these represent poor economic policy and poor foreign policy, proponents of less restrictive controls—the general business community and the Office of Trade—point out that more stringent restrictions merely increase the sales of similar products by European manufacturers who, it must be emphasized, presently sell at least as many dangerous products in world markets as we do. Also, overly restrictive controls could result in the relocation of manufacturing facilities abroad, and neither of these alternatives are particularly helpful to our domestic economy or balance of trade.

Most responsible people do agree with the principle of banning export of truly dangerous or hazardous materials. Some agencies of the U.S. government, however, in their sometimes overzealous attempts to protect the U.S. consumer from everything, can restrict sales of substances that are only potentially hazardous or products that are dangerous only if misused. Such moves can cause disruption and economic hardship—remember the cranberry scare of the late 60s or the more recent saccharine almost-ban?

Recent Developments. The federal task force's latest report draft recommends more uniform advance notice to foreign governments in countries about to receive shipments of goods banned in the U.S., the publication of an annual summary of all federal regulatory actions on banned or restricted hazardous substances, and the banning of the export of severely hazardous materials. Materials termed severely hazardous are those that could cause present or future danger to the international community, an innocent bystander nation, or the U.S. itself. The determination of severe hazard would be made by an interagency task force of the Departments of State and Commerce, and other appropriate regulatory agencies. It is estimated that about 100 items would be initially included on the severe hazard list.

On another front, the U.S. Consumer Product Safety Commission has recently taken a leadership role in developing a system within the Organization for Economic Cooperation and Development to share information on shipments of dangerous consumer products. The OECD is a prominent international organization of 24 industrialized nations, including many European countries, the U.S., Canada, and Japan. Currently, OECD maintains a system of voluntary notification by which member nations share information about product safety standards and bans on items such as chain saws, asbestos, and toys and other children's products. This system is now expected to be expanded to include additional products such as tires and automobiles, any products subject to recall, proposed safety standards and bans, and product safety research.

For a long time the CPSC was interested only in products for domestic consumption, and the laws administered by CPSC prohibited export of consumer products which violated any agency standard or ban only if those products had been in domestic commerce. Until 1978, CPSC had no control over articles manufactured and labeled solely for export. That year, however, Congress amended the law, and CPSC has now issued regulations to require:

1 Thirty-day advance notice to CPSC by any person who intends to export any product which fails to comply with any product safety standard or ban

2 Notice by CPSC to the country of destination—including shipment dates, name of the consignee, and information as to how the product violates the relevant standard or ban. Also, CPSC can now prohibit the exportation of certain products which might, in the future, pose a hazard to U.S. consumers, for example, through reimportation, residues on imported crops, air or water transport, or illegal diversion.

A Reasonable Approach. The vast majority of American producers and manufacturers want to comply, and do comply, with the law. To encourage compliance, laws and policies must be as clear and equitable as possible. The recommended plan of relying on informed choice—letting importing countries decide whether or not to accept a shipment after all relevant facts are disclosed—seems to be a reasonable approach to the problem, and does not smack of excessive governmental interference. Those in the industrial community who might complain about increasingly restrictive controls and regulations would do well to consider TRIS and leptohos, and how these situations invite the very interference they so abhor.

—R. S. Hattersley, P.E., Mem. ASME.

the ASME News

Society Activities and Events • *Joyce Moskowitz*

1980 Industrial Power Conference

Industrial Power for the 80s: The Turn to Coal

Industrial Power Conferences have been held annually since 1971. Their purpose has been to provide a forum dedicated to the technology of industrial power generation. In this they have been very successful, if one judges by the quality of technical presentations and the participation and information-sharing of the audience.

This year's meeting at the end of October in Houston, Tex., met those criteria of success and in one respect—format of paper presentation—added a new one. Each author presented only a summary or update of his paper, which left ample time for questions and discussion. Conference attendees, encouraged to read the preprinted papers prior to the sessions, were thus armed with sufficient knowledge to engage in a fruitful exchange of experience and ideas with the authors. What follows are some highlights of the technical presentations.

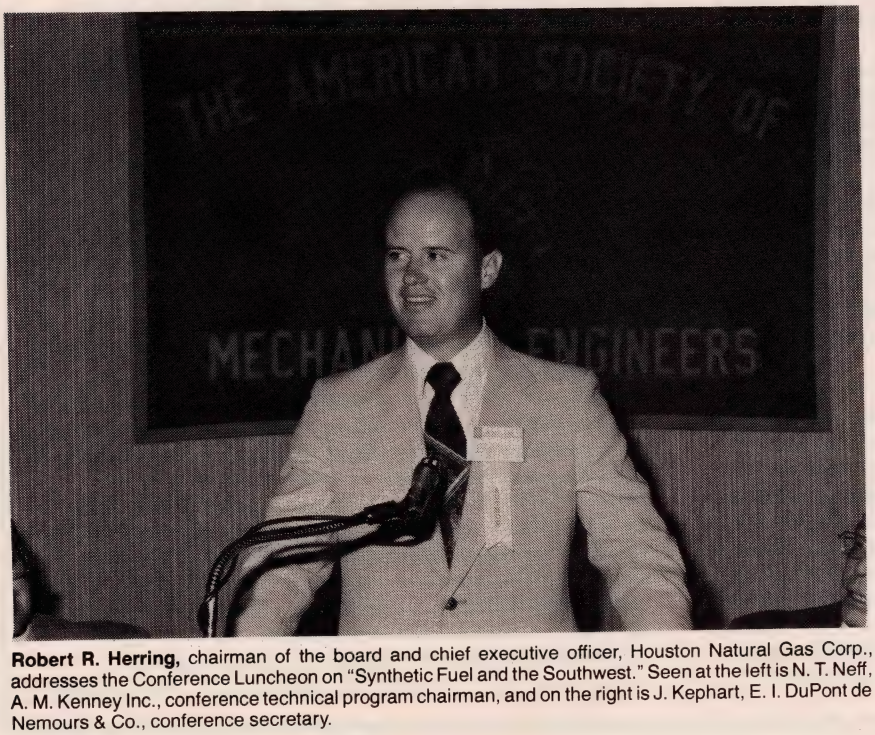
Reconversion of an Industrial Steam Plant to Coal Firing. Three major factors are pushing many industrial steam-producing energy consumers to the use of coal: limited supplies of petroleum fuels, unpredictable energy costs, and state and federal regulations regarding the use of these fuels in boilers. Although coal is not the most convenient or easily utilized fuel (one quickly thinks of the logistics of the matter — transportation, storage areas, and extensive facilities needed to prepare the coal for burning), there is a long-term supply of it and it's readily available in most regions of the U. S.

L. W. Mullins, senior engineer with Union Carbide Inc., in Ponce, P.R., talked of his plant's experience in this area. The steam plant covered in his presentation consists of three identical Combustion Engineering boilers rated at 250,000 lb/hr at 1000 psig and 800°F (113,400 kg/h at 6.9 MPa/430°C). Two 6-MW turbine/generators are supplied from the common 1000-psig (6.9 MPa) steam header. The turbine exhaust steam is 4000 psig (27.6 MPa), which goes to the plant process steam header. Safety and environmental concerns, said Mullins, were foremost in consideration during the early development states of the reconversion project. These concerns dictated the design and selection of systems and equipment.

There were four basic project objectives:

- Upgrading the operation to achieve operating cost savings and minimize operating cost increases inherent with firing coal.
- Upgrading the plant to meet safety/industrial hygiene requirements which have been adopted since the plant last operated on coal. (Plant was originally designed for coal, before switching to oil.) OSHA and NFPA regulations were considered in designs for coal handling equipment and working areas and in burner flame safety systems.
- Meet specific regulations and constraints imposed by external forces. Such constraints are primarily environmental. These took the form of electrostatic precipitators and emission monitoring equipment and fly-ash removal equipment.
- Provide reliability and flexibility of operations as required by project sponsors. These requirements necessitated the addition of fuel oil handling, storage and firing capabilities, and rtention of the existing gas firing capabilities. System designs were arranged to allow full-capacity operation on any single fuel or on multiple fuel combinations.

The facility is now operating on coal in compliance with federal and state air quality regulations. The hotside precipitators have been successful, with little problem other than normal shakedown. The burner management system has performed satisfactorily with the use of programmable controllers. And despite numerous shakedown problems, reported Mullins, the coal handling systems are now providing reliable service. The end result has been a reduction in energy costs by as much as $5 million annually over the previous mode of operation. And, in addition, fuel flexibilities, the new controls, and new auxiliary equipment should ensure a reliable and flexible operation that will meet operational needs and changes for many years, added Mullins.



Robert R. Herring, chairman of the board and chief executive officer, Houston Natural Gas Corp., addresses the Conference Luncheon on "Synthetic Fuel and the Southwest." Seen at the left is N. T. Neff, A. M. Kenney Inc., conference technical program chairman, and on the right is J. Kephart, E. I. DuPont de Nemours & Co., conference secretary.

NO_x, SO_2, and Particulate Control. Pollution control equipment has become a major design item in power plants both from an engineering and a cost viewpoint. The three primary pollutants that require control on boiler installations are nitrogen oxides, sulfur dioxide, and particulates. H. M. Deboe and R. C. Lutwen of the firm of Campbell, Deboe & Assocs. discussed various methods available for the control of these three pollutants.

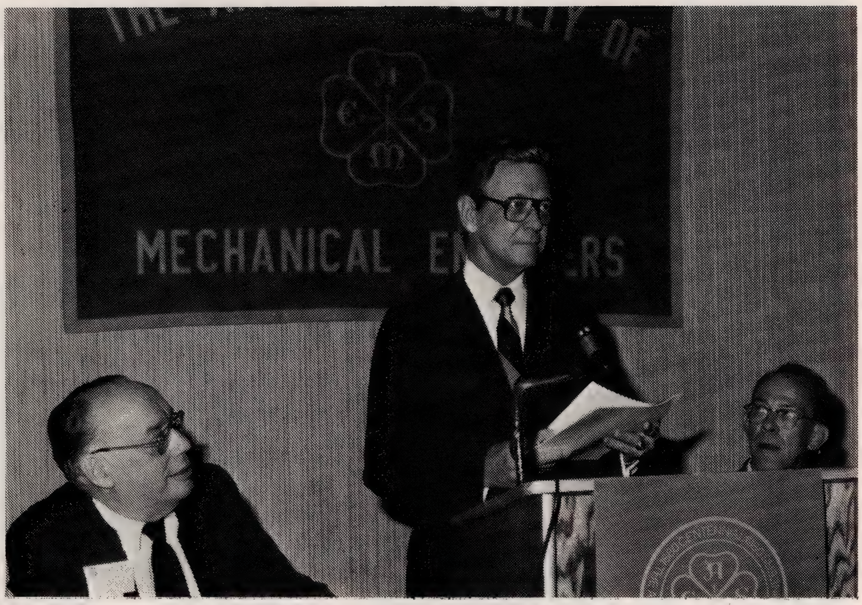
Nitrogen Oxides. One of the unfortunate points of NO_x formation, said Deboe-Lutwen, is that the more efficient the combustion process, the higher the NO_x formation. The best method to reduce NO_x is to starve the flame area of oxygen so that the oxygen available to form NO_x is limited. Unfortunately, this leads to increased coal ash slagging, furnace corrosion, and high unburned combustible loss. The various methods that can be used to decrease the NO_x formation in a pulverized coal-fired boiler are:

- Tangential Firing. Fuel and air are inserted in the corners of the furnace and directed to the middle of the furnance where the combustion takes place. The flame pattern is long and the NO_x generation is fairly low.
- Turbofurnace. This is similar to tangential firing since the flame pattern is long and is combined with flames from other parts of the furnace. With this method the amount of air put into the combustion zone is critical, with slagging and corrosion a hazard if the air flow is maintained too low.
- Front Firing. Some boiler manufacturers use conventional front firing with different methods required to decrease NO_x. Those methods include burner design, air distribution, burner location, and burner and furnace configuration.

There are also other methods. One is NO_x scrubbing. This is accomplished by injecting ammonia into the gas stream.

Particulate. The present particulate federal requirement for industrial boilers above 250 million Btu/hr, noted the authors, is 0.03 lb/million Btu/hr. The two most utilized methods are bag houses and electrostatic precipitators. There are two types of bag houses: "reverse air," sometimes called "inside bag collection" and "pulse jet."

When this type of unit is cleaned, the gas flow to a section is shut off and air is directed from the top through the cavity around the bags. The air passes through the bag to the inside and carries the dust with it to the bottom of the bag house where it is collected in a hopper.



L. W. Mullins, speaking on "Experience in Reconverting an Industrial Steam Plant to Coal-Firing."

With the "reverse air" method, the dirty gas flow enters the bag house inside the bags and as it passes through the bag to the cavity around the bag, the particulate is collected on the bag. The gas then flows in the cavity to the top of the bag house and the clean gas leaves. In the "pulse jet" method the dirty gas flows into the bag house in the cavity and flows through the bag to the inside where it is directed to the top. The particulate is collected on the outside of the bag. When the unit is cleaned a pulse of air is directed down the middle of the bag at a pressure that expands the bag. During this process the particulate is separated from the bag and sent to the bottom of the chamber where it is collected in a hopper.

- Electrostatic Precipitator. This type of device has been used extensively for particulate control. There are two types: "rigid frame" and "weighted wire." The rigid frame precipitator is primarily a European design and is more rugged, larger, and more costly. The electrodes are supported from the bottom with a structurally sound design. The weighted wire design has weights that are hung at the bottom of wires as part of the electrode system. These wires have a tendency to break, causing design concerns for the weighted wire precipitators.

One of the problems encountered is that precipitators are design-sensitive to the sulfur in the coal. As sulfur content decreases, the ash particles' resistivity to accepting a charge increases. Since this resistivity is temperature-sensitive, some precipitators must accept hot gases to overcome low sulfur contents. This leads to larger sizes, higher costs, and more maintenance.

Sulfur Dioxide. SO_2 is formed by the combination of the sulfur in the fuel being burned with available oxygen during the combustion process. There are various methods available to decrease SO_2. One is fluid bed combustion where SO_2 is reduced during the combustion process itself by adding limestone in with the coal. Other methods require reduction of the SO_2 in the flue gas stream leading from the boiler. There are throwaway systems where the end chemical product with the captured SO_2 is discarded and by-product systems where the end chemical product can be sold. Deboe-Lutwen addressed the throwaway system. The three methods that are generally considered viable for industrial applications are lime/limestone systems, dual alkali systems, and the new emerging dry scrubbing systems.

Lime/Limestone Flue Gas Desulfurization System. This system uses a slurry of calcium carbonate or calcium oxide to absorb SO_2 in a wet scrubber. Although the overall reactions are complex, the final compounds include calcium sulfite and calcium sulfate in addition to the unreacte lime or limestone. The calcium sulfite and sulfate are precipitated in a holding tank which is designed to provide adequate residence time for this precipitation as well as a place for dissolution of the added limestone. The overflow from this tank is recycled to the scrubber and a small slip steam is sent to the waste disposal system.

Double Alkali Scrubbers. These are similar to the lime/limestone scrubbers in that a calcium-based sludge is produced for disposal. Unlike the lime/limestone processes the absorption of sulfur dioxide and the formation of waste products for disposal

View of rapt audience during talk by F. Abegg III on "Burning Coal in Alaska—A Winter Experience."

occur in separate system components. The double alkali process normally uses a soluble sodium-based alkali for SO_2 absorption and a calcium-based alkali to regenerate the active sodium solution. The absorption of SO_2 is accomplished in an absorber similar to those utilized in a limestone system using a soluble sodium alkali which minimizes scaling and solids buildup in the scrubber without requiring as stringent pH requirements. The scrubber effluent is then sent to a reactor tank, where it is mixed with slaked lime for regeneration of the sodium scrubbing medium and the formation is insoluble calcium salts. The slurry stream containing calcium sulfite/sulfate solids is sent to a thickener where the solids are concentrated for disposal.

Dry Scrubbers. Coals that contain low percentages of sulfur many times also have a significant amount of alkali compounds in the ash. The dry sulfur removal system is designed to take advantage of both of these factors. In the dry system the flue gas is intimately mixed with a slurry of reagent, such as slaked lime. In the presence of lime, moisture, and reactive fly ash, a high percentage of the gaseous SO_2 is reacted to form solid sulfates and sulfites. These can be removed from the gas stream along with the flue gas particulate matter with either an electrostatic precipitator or a filter bag house.

Economics of Selected Fuels. O. H. Klepper, who is with the Oak Ridge National Laboratory, described his attempt to assess the future economic potential of a group of coal-derived fuels—some already in use and others proposed — for new industrial steam capacity. Retrofit applications to existing systems were not considered. His main emphasis, he said, was placed on coal-fired systems and other technologies that could be commercialized by the early 1990s. The following fuels were selected: coal for conventional- and fluidized-bed firing; low-, medium-, and high-Btu gas; coal-oil mixture; methanol; oil; and natural gas (included only for reference purposes). Steam applications took in process heating, shaft work, and on-site electrical generation. Boiler capacities ranged from 6.3 kg/s (50,000 lb/hr) of steam to 126 kg/s (1,000,000 lb/hr), boiler sizes where coal-firing would often be considered.

His approach, he said, was rooted in cost extrapolations derived from a number of sources. Ranking of the various fuels and boiler technologies was on the basis of minimum life-cycle steam costs during the time period from 1990 to 2010. The cost of petroleum-based fuels and coal was based on Energy Information Administration forecasts prepared in 1979; the cost of synthetic fuels was derived from coal conversion plant characteristics reported in the literature. Boiler capital, operating, and maintenance costs were adapted from architect-engineer estimates. Industrial steam capacity expansion around the year 1990 was estimated as a function of size, capacity factor, and geographical region. All of these aspects, plus some others, were examined in depth in his discussion.

Other Presentations. Some of the other topics covered were: steam conditions for large coal-fired cogeneration plants, an analysis of energy conservation gains versus production curtailment risks, a reference plant concept for cogeneration, advances in the treatment of cooling tower blowdown, boiler size selection for industrial plants with multiple boilers, and burning coal in Alaska under winter conditions. —*S. W.*

Digests of numbered ASME papers appear in the Technical Digest section of *Mechanical Engineering*. Keep posted on current engineering information. Order papers by using the handy tear-out form we provide.

Rogers Finch Resigns as ASME Director

Dr. Rogers B. Finch, executive director of the ASME since 1972, tendered his resignation to Council at its meeting in Chicago on Nov. 21, 1980.

The Council accepted this resignation and expressed its appreciation for the many contributions that he has made over the years he has held the post of executive director. It has been during this tenure that the Society has developed to its present position as a key leader of the engineering profession.

Dr. Peter Chiarulli, deputy executive director, will carry out the duties of the executive director during the interim until a successor has been appointed.

ASME LANDMARKS PROGRAM

Blood Heat Exchanger Named Landmark

The first commercial human blood heat exchanger was developed in 1957 to shorten the time normally required to cool a patient before open-heart surgery and to rewarm the patient after surgery. The device, jointly developed by engineers of Harrison Radiator Div., General Motors Corp., Lockport, N.Y., and by medical researchers such as Dr. Ivan W. Brown from the Duke University Medical Center in Durham, N.C., was designated a national historic mechanical engineering landmark by ASME at a ceremony last September at the Amherst Campus of the State University of New York at Buffalo.

Before the invention of the blood heat exchanger, the body temperature of a patient was lowered by either a refrigerated blanket or an ice pack — risky processes that required one to two hours of anesthesia before the operation could begin. By reducing the time for cooling and rewarming from several hours to a matter of minutes and by more precisely controlling the temperature level, the blood heat exchanger proved an invaluable asset.

Today it is standard practice to use the blood heat exchanger for open-heart surgery, and it is employed on all heart-lung machines in the world. The exchangers are either disposable or are built into the disposable blood oxygenators. Furthermore, their use has been expanded to deep hypothermia for special types of surgery and to thermally enhance the anti-cancer effects of chemotherapy agents used to perfuse isolatable regions of the body.

Although the original Brown-Harrison heat exchanger has been superseded by lower-cost disposable models, it remains the standard. Some of the original models are still in use today. One of them has been placed on permanent display in the Science and Engineering Library at the State University of New York at Buffalo.

Society Execs Meet at UEC

Top executives from five of the oldest engineering organizations met for a work session in the United Engineering Center in September. The five founder society presidents pictured here are, left to right: Charles E. Jones, ASME; M. Scott Kraemer, AIME; James Oldshue (past president), AIChE; Joseph S. Ward (past president), ASCE; and Leo Young of IEEE. Also present were heads of staff of each society.

1980 eastern design engineering conference

1

1

A new plastic called Sorbothane that makes an egg hammer-proof...a bicycle that folds up...conveyor belts that can make sharp U-turns...an exercise machine with a built-in microprocessor: These were among the 129 exhibits that were on display at the New York Coliseum, Oct. 28–30, 1980. The show ran concurrently with the ASME Design Engineering Conference, which featured such sessions as: the human factor in design, home computers in design engineering, designing with composites, solving vibration problems, and voice interfacing in product design.

2

Nicolet Instrument Corp. Oscilloscope Div. The Nicolet Explorer Oscilloscope, with a digital memory, digitizes wave forms and can be used for transducer output, materials testing, and mechanical and electromechanical testing in the d-c to 7-MHz range.

3

Zanderer Associates Inc. and Wittek Manufacturing Co. displayed this collage of chemically edged metal parts. The parts are components of computer peripherals that have various electronic applications.

4&5

Polaroid Corp. This movie camera (4) is part of a new instant motion analysis equipment system that takes color movies of mechanical motions using standard high-speed methods, but plays back almost instantly. The cassette of exposed film is put through the Polaroid Polavision Analyzer and results are available for viewing in slow motion or frame by frame 90 s later. The film was rolling for a demonstration at the show (5), as a karate expert chopped wood with his bare hands.

6

Titeflex Industrial Products Group demonstrated their Bundy Tubing by displaying a talkative "robot" made, of course, from tubing.

7

Thomson Industries Inc. ball bushings are used to create friction-free linear motion.

8

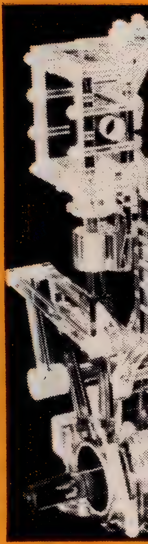
Glasflex Corp. displayed their new Stanley Steamer, an acrylic (transparent) reproduction of the compound twin cylinder steam marine engine design that was originally developed 75 years ago. The engine's plastic components were formed with tolerances usually associated only with metal parts.

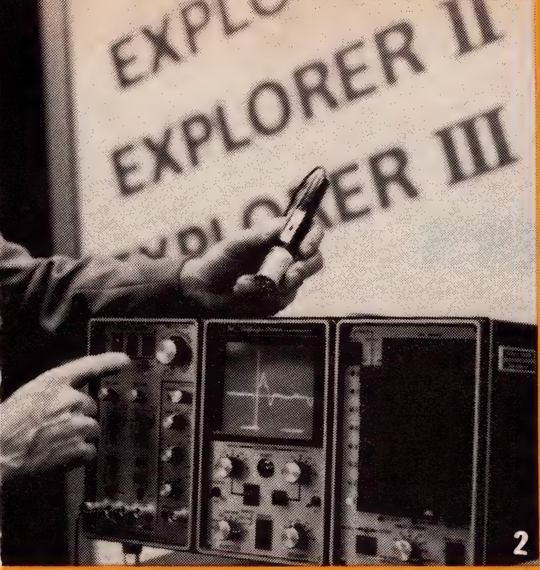
9

Alloy Products Corp. uses a metalworking method called "hydroforming" for custom-made deep-drawn machinery parts. The stainless steel pressure vessels on display were made in accordance with ASME codes and standards.

10

Midland Ross's Nylomatic Unit does custom molding of plastic mechanical components. The model train was made of polystyrene.





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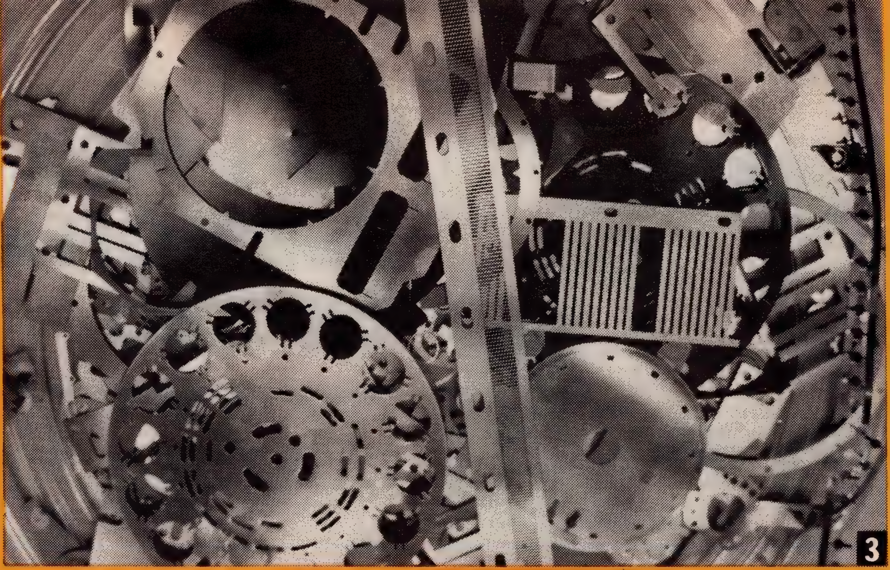
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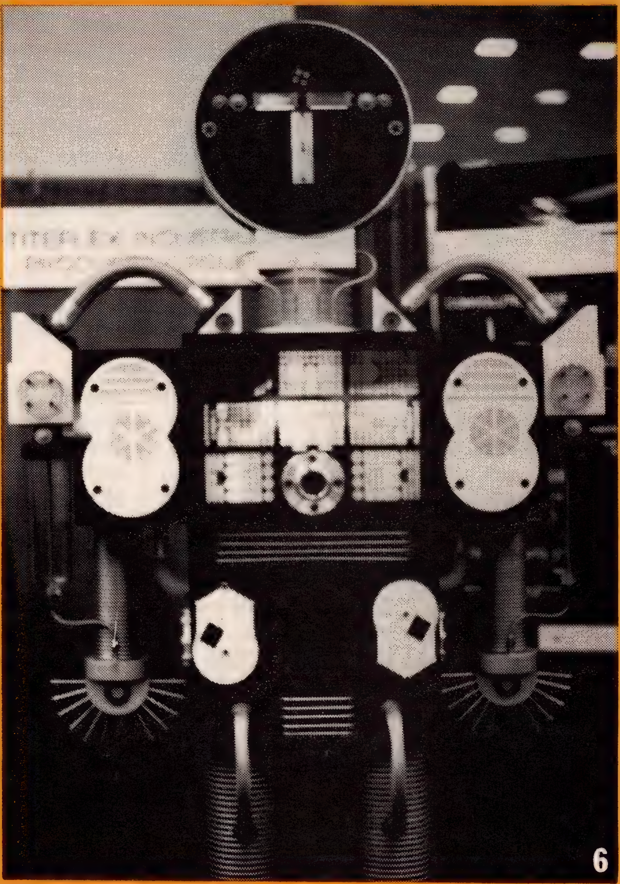
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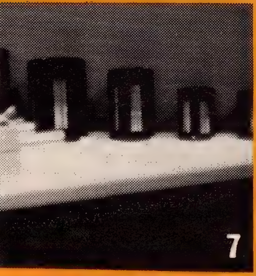
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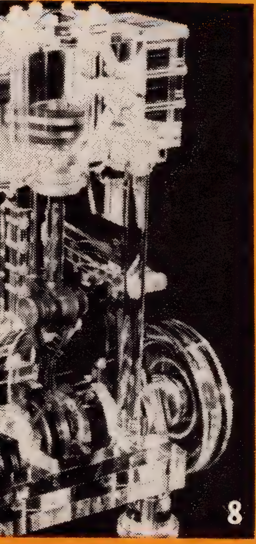
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1981-1982 ASME Officers Elected

Results Announced at WAM Business Meeting in Chicago

This year the members of ASME had a greater opportunity than ever before to choose those individuals who will next govern the Society. The membership elected the first ASME Board of Governors, who will take office in June 1981. Results were announced by ASME President Charles E. Jones at the 1980 WAM Business Meeting. This new governance concept has been developed over the past few years as part of the Society's restructuring effort. The Board will be composed of 10 members: president, president-elect, and eight at-large governors who will typically serve two-year terms. This initial year, however, there were four individuals elected for one-year terms, and four for two-year terms.

This year the National Nominating Committee departed from the Society's traditional pattern of single-slate presidential and vice-presidential nominations and, for the governor nominations, offered to the membership an election choice from a number of candidates. The eight governors were elected out of a slate of 12 individuals who were nominated by the 1980 National Nominating Committee.

Gaither Elected 100th President of ASME

Robert B. Gaither will bring to the Society presidency 25 years of experience as a professor, academic supervisor, and university department chairman. Gaither is currently professor and chairman of the Department of Mechanical Engineering at the University of Florida, Gainesville, a position he has held for the past 16 years.

Gaither has served ASME in many capacities since he joined in 1956. He currently is the vice president, Policy Board, Education (1976–80), as well as a member of Council CRA and CTA for the same period. He also is a member and past chairman of the Regional and National Mechanical Engineering Department Heads Committee, and a member of both the Power Division and the Ocean Technology Division of the Society.

In the early 1950s, shortly after graduating from the Alabama Polytechnic Institute in Auburn, Gaither joined the Navy. As a line officer he gained experience as a marine engineer, explosive ordnance disposal officer, and executive officer. After four years in the service, Gaither returned to his studies and received his master of science degree in mechanical engineering in 1957, and a doctorate in 1962, both from the University of Illinois in Urbana.

Gaither's first teaching position was as an assistant at the University of Illinois, 1955–57. He was then promoted to instructor, and remained in this position for five years. When he joined the staff of the University of Florida in 1962, Gaither was an associate professor and academic supervisor at the Palm Beach Graduate Center, as well as an associate research professor in the University's M. E. Dept. Two years later, he became chairman of the department, as well as a professor. Gaither has acted as a consultant for Babcock and Wilcox, GE, the states of Illinois and Florida, and several educational institutions.

In addition to ASME activities, Gaither is active in ASEE, ECPD, Pi Tau Sigma, Tau Beta Pi, and Sigma Xi professional and honorary societies. He has held national chairmanships in two divisions of ASEE, and has served as a member of the Board of Directors of ECPD (1976–79). Among his list of honors and awards is a Ford Foundation Fellowship (1959–62).

Gaither has published several papers on topics including flame temperature measurement, heat and power production, statistical thermodynamic , and electron gas behavior in plasma flows. At the University of Florida he introduced an off-campus graduate program in engineering leading to the master's degree, and initiated a mechanical engineering Ph.D. program. Also, at the University he is credited with developing the mechanical engineering department into a top-notch educational and research unit, and with developing the faculty, defining its goals, and inspiring a harmonious atmosphere.

Governors

Board of Governors—1981-82

H. Norman Abramson, Hon. Mem. ASME, P.E., vice president, Engineering Sciences Div. and director, Dept. of Mechanical Sciences at the Southwest Research Institute, San Antonio, Tex., is a prominent figure in the field of theoretical and applied mechanics, particularly in aeronautics and astronautics. He has conducted important work in marine and earthquake engineering, ship structural analysis and dynamics, and hydroelasticity. Author of over 73 published papers and over 120 public lectures, Abramson is a fellow of AAAS and AIAA, a member of the U.S. National Academy of Engineering and the Society for Experimental Stress Analysis, and SNAME, to name but a few. A 1956 Ph.D. in engineering mechanics from the University of Texas, Abramson has served as engineer, Aerodynamics Section, U.S. Naval Air Missile Test Center at Point Mugu, Calif.; research assistant, Stanford University, Calif.; project analytical engineer, Chance Vought Aircraft; associate professor

of aeronautical engineering, Texas A&M University, College Station; and consultant to the Dept. of Oceanography. He joined SWRI in 1956 and assumed his present titles in 1972. Recent ASME activities include vice presidency of the Basic Engineering Department (1974–1978), and associate editorship of *Applied Mechanics Reviews* since 1954. Abramson belongs to the National Academy of Engineering.

Robert Plunkett, Fellow ASME, P.E., professor of mechanics, University of Minnesota, Minneapolis, has written nearly 60 technical papers in the field of applied mechanics and is the author of *Mechanical Impedance Methods for Mechanical Vibrations,* published by the Society in 1958. After MIT awarded Plunkett a doctorate in mechanical engineering in 1948, he joined the faculty of Rice University, Houston, Tex. Three years later he became a consulting engineer in applied mechanics for the General Electric Co. Since 1960, the year he took up his present post at the University of Minnesota, Plunkett has consulted for such groups as Honeywell Corp., Minneapolis, Minn.; the Ford Motor Co., Detroit, Mich.; the U.S. Armed Forces; and the Nuclear Reactor Safeguards Council of GE. Plunkett has served on the Nuclear Noise Advisory Committee of the U.S. Navy, the Department of Defense's Materials Advisory Board, and the National Academy of Science's Committee on Basic Research. Plunkett is a fellow of ASA and AAAS, an associate fellow of AIAA, and a member of ASEE, SESA, and the National Academy of Engineering. Recent ASME activities include serving as a member of the Headquarters Location Committee since 1978, as chairman of the Budget Committee (1977–1978), and as chairman, Committee on Technical Affairs (1974–1976).

Roy P. Trowbridge, Fellow ASME, director, Engineering and Standards, General Motors Corp., G.M. Center, Warren, Mich., has participated in industrial, national, and international standardization activities for almost 50 years. Over the years he has been working actively with the United States of America Standards Institute, General Standards Council of the SAE, AMA Committee on Motor Vehicle Identification, International Standards Organization conferences, Board of Codes and Standards of ASME, U.S. Department of Commerce Panel on Engineering and Commodity Standards, Industry Advisory Committee on Military Drafting Standards, and the USA Committee for American-British-Canadian Standards Activity, to name a few. Particularly noteworthy are his contributions to the American National Standards Institute and ASME on the promulgation and development of technical standards. Trowbridge has served ANSI as president, and has been vice president of the USA Standards Institute. Recent ASME activities include the vice presidency of the Policy Board, Codes and Standards (1976–1980), and membership on the Budget Subcommittee, Centennial Steering Committee, and ASME ad hoc Metric Study Executive Committee.

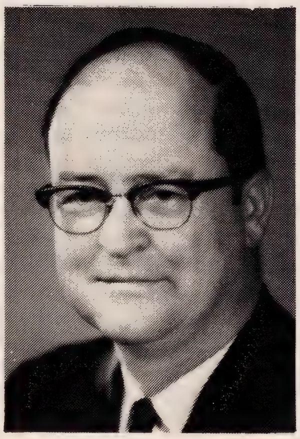
William J. Warren, P.E., is president, Paul L. Armstrong Co., Inc., South Pasadena, Calif., a company that represents manufacturers of pumps and related equipment for application to refinery and process plant work. A 1950 chemistry graduate of the University of California, Berkeley, Warren began his career as an assistant assayer for the Coronado Copper and Zinc Co., Ingot, Calif., and was promoted to assayer within six months. After working as a chemist for Sherwin-Williams Paint Co., Emeryville, Calif., for one year, Warren joined the firm of Paul L. Armstrong Co. as a sales engineer in 1952. He rose to the presidency of the company in 1962. Recently, Warren has chaired the Meetings Committee of ASME's Policy Board, Communications (1978–1980), and has served as that board's member-at-large since 1977. He was also finance chairman for ASME's Centennial Rose Parade Float Committee (1978–1979), and he chaired the Arrangements Committee of the Society's Century 2 ETC.

Board of Governors—1981-83

Serge Gratch, Hon. Mem. ASME, P.E., and a Ph.D. from the University of Pennsylvania, Philadelphia, Pa., is director of the Chemical Sciences Laboratory, Ford Motor Co., Dearborn, Mich. Gratch joined the Ford Motor Co. in 1961, after work as a senior research scientist and as an associate professor at Northwestern University. His work has involved the development of electric cars, exhaust catalysts, and new fuels. A leader in these areas, he headed the Inter-Industry Emission Control Program, which combined the forces of the automotive and petroleum industries to minimize exhaust pollution while improving fuel economy. His research on alternative fuels led to his appointment by President Carter to the U.S. National Alcohol Fuels Commission. He has held many research management positions at Ford, including the positions of manager of the chemical processes and devices department, and assistant director of engineering sciences. Gratch belongs to ACS, AIAA, SAE, ASEE, NYAS, and three honor societies, and is a fellow of AAAS. Within ASME, he has served as chairman, Committee on Planning and Organization (1979–1980), chairman, Committee on Research Needs (1978–1979), and vice president, Research (1973–1977). Other recent ASME activities include representing the Society to the Engineering Foundation Projects Committee (1977–1980).


ABRAMSON


PLUNKETT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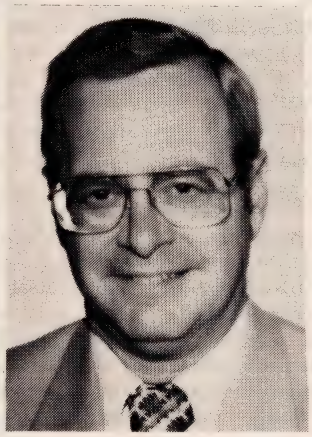
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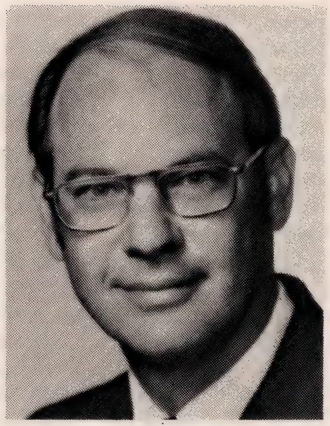


VACHON

George Kotnick, P.E., project engineering manager, United Engineers and Constructors, Philadelphia, Pa., is an authority on power plant automation, and a keen public speaker on energy and the environment. Kotnick is a graduate of Oklahoma State University, Stillwater. He worked for 27 years for the Philadelphia Electric Co., designing production facilities for suburban natural gas supply and distribution systems and nuclear and fossil steam stations, and supervising project and architect engineers responsible for the design and purchase of water and air pollution abatement systems. In 1979 he joined United Engineers and Constructors, where he now manages the engineering and procurement of a sulfur dioxide removal system for two 850-MW coal-fired electric generating units. Active in Philadelphian civic affairs, Kotnick belongs to three honor societies, as well as the Air Pollution Control Association, the Delaware Valley Council's Clean Air Committee, the Edison Electric Institute's Energy and Environment Committee, and ANS. Recent ASME activities include Constitution and By-Laws Committee (1980–), chairman, Committee on Regional Affairs (1978–1980), member, Century 2 Post Convocation Committee (1978–1979), member, Executive Committee of Council (1978–1980); and vice president, Region III (1976–1978).

Frederick F. Ling, Fellow ASME, directs the Dept. of Mechanical Engineering, Aeronautical Engineering, and Mechanics at Rensselaer Polytechnic Institute, in his capacity as department chairman. He has held the post since 1956, and has worked extensively in the areas of lubrication and tribology. Before entering academics, Ling worked as a structural, mechanical, and project engineer for two firms. In 1954 he was appointed assistant professor of mathematics at Carnegie-Mellon University. After joining Rensselaer, he took several temporary assignments, including one as visiting professor of mechanical engineering at the University of Leeds, in England, from 1970 to 1971. Ling has acted as a consultant to the Southwest Research Institute, General Electric Co., and the Mitre Corp., among other firms. He is the author of many books, among them *Surface Mechanics* (Wiley, 1973). He has received many professional honors, and is a member of the National Academy for the Advancement of Science, ASLE, American Physical Society, and numerous other organizations. Recent ASME activities include serving as chairman of the Energy Policy Committee since 1978, vice president, Research, since 1977, and member of the Executive Committee of Council (1979–1980).

Reginald I. Vachon, Fellow ASME, P.E., president, Vachon, Nix, and Assocs., Atlanta, Ga., is prominent in the thermosciences, as a researcher, author, and policymaker. Vachon — who holds a Ph.D. and LL.B. — is also professor of mechanical engineering at Auburn University, Auburn, Ala., whose faculty he joined in 1963. Author of many technical articles, Vachon has written papers that have appeared in ASME's *Journal of Heat Transfer,* among others. His research has ranged from individual projects to multidisciplinary projects on energy, housing, and information systems. Vachon is a member of NSPE, ASEE, and AIAA. Recent ASME positions include member of Professional Affairs and Ethics Committee (1980–1981), vice president, Region XI (1978–1980), chairman, Committee on Legal Affairs, since 1979, member of the Executive Committee of Council (1979–1980), and member of the Committee on Planning and Organization (1977–1978).

Vice Presidents of Regions and Policy Boards

Region II

Richard S. Touma, assistant vice president for research and special projects, Fairleigh Dickinson University, Rutherford, N.J., is in charge of all research and development activities within the university and represents Fairleigh Dickinson to all external bodies relating to patents, copyrights, and R&D. One of Touma's responsibilities within the university lies in governmental regulation compliance in the areas of human and animal protection. Before joining FDU's staff in 1962, Touma was technical editor for Coastal Publications, New York, N.Y., and design and liaison engineer for the Bell Helicopter Corp., Fort Worth, Tex. A master's of mechanical engineering graduate of the City University of New York, N.Y., in 1962, Touma has served on many New Jersey State committees, including the Teaneck Committee on Community Relations, the Bergen County Community Action Program, and the New Jersey State Dept. of Education's Board on Government Relations. He has spoken publicly to a variety of audiences, including universities and business groups. Recent ASME activities include charge of Planning, Region II (1979–1980), membership in the Evaluation and Audit Committee, Region II (1974–1976), and at-large membership in the Policy Board, Professional and Public Affairs (1975–1978).

Region IV

Robert A. Vogler, P.E., power and steam unit manager since 1977 for the R. J. Reynolds Tobacco Co., Winston-Salem, N.C., is responsible for all company utilities, and for the management of a staff of 200 and a $25-million budget. He first joined Reynolds as a junior engineer in 1959, the year he graduated from North Carolina State University, Raleigh. At Reynolds he gained experience in design and project coordination. Four years later Vogler was promoted to plant engineer, in charge of all company utilities in one of four locations. Active in civic affairs, Vogler was appointed in 1975 by the County Commissioners to the Recreation Commit-

tee, and in 1976 to the Alcoholism and Residential Authority, which he was to chair in 1980. Recent ASME activities include chairmanship of the National Membership Development Committee, participation in the Region IV Policy Board, and chairmanship of the Region IV Membership Development Committe. Vogler is also a member of the NSPE.

Region VI

Gus C. Nick has been president since 1952 of Somes-Nick & Co., Chicago, Ill. The company, which Nick cofounded, represents manufacturers of power transmission equipment, heat exchangers, and vacuum and related equipment for the chemical and petrochemical refining, public utility, and industrial plants in the Midwest five-state area. Nick brought to bear on his lengthy presidency of Somes-Nick a B.S. in mechanical engineering from Yale in 1946, a degree from the General Motors Institute of Technology, and service in the U.S. Navy. Furthermore, he had gained industrial experience by working as a regional sales engineer specialist in centrifugal processes and refrigeration compressors for the Carrier Corp. from 1947 to 1952, the year he founded his company. Recently Nick has served on the Society's National Membership Development Committee, on the Policy Board, Member Interests and Development, on the Region VI Membership Development Committee — all from 1977 to 1979; and as secretary, Region VI, since 1979. Nick has also chaired the Chicago Section's History and Heritage Committee.

Region VIII

George A. Jacobson, manager since 1978 of the Plant Pumps Section, Westinghouse Hanford Co., Richland, Wash., is responsible for mechanical equipment for the Fast Flux Test Facility (FFTF), a fast neutron reactor, and for design, customer relations, and startup problem resolution. He graduated from the University of Michigan in Ann Arbor in 1963 with a BSME and received a master's in mechanical engineering at California State University in Sacramento in 1969, while working for the nearby Aerojet General Corp. By 1971 Jacobson had advanced to project engineer for Aerojet, developing high-performance attitude control system rocket engines for missile and man-rated systems and long-life graphite composite and electroformed thrust chambers for propellant combinations. Three years later, as senior engineer, he was working on components for liquid metal service for the FFTF, and he became a principal engineer in 1977. Recent ASME activities include vice chairmanship of the Public Affairs Committee (1980–1981), service as member and secretary of that committee since 1979, and as a member of Region VIII Policy Board, Public Affairs (1976–1979).

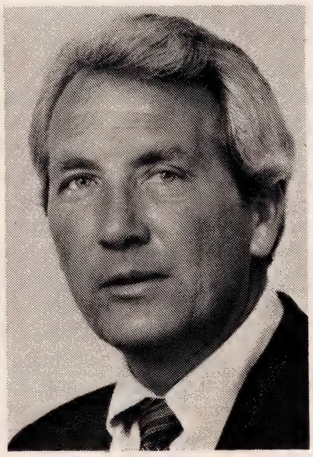
Region X

Albert E. Woelfel, senior project development specialist since 1974 with Cameron Iron Works, Inc., Houston, Tex., has applied his proficiency in valves, pressure vessels, and flow control devices to the direction of a development project that produced a series of high-pressure gate valves with integral operators and transducers. His 16 patented inventions here and abroad testify to his ingenuity as a designer. Woelfel also led a group of engineers during a three-year joint program with Gulf Research and Development Co. in the design and construction of a remote-controlled underwater Christmas tree for oil and gas wells. He graduated from Rice University, Houston, Tex., in 1947 with a BSME, and two years ago with an MME. Woelfel's tenure with the Cameron Iron Works dates from 1957, when he became a senior development engineer in the Research and Development Dept. of Cameron's Oil Tool Div. Six years later he was promoted to chief engineer for gate valve engineering, but returned to oil tool research in 1967. Active in the Lutheran Church and in civic affairs, Woelfel, a P.E., recently became a member of ASME's National Membership Development Committee, a member of that committee's Centennial Committee (1978–1980), and a member and chairman of ASME's Ocean Engineering Division.

Professional and Public Affairs

Nancy D. Fitzroy, Fellow ASME, P.E., advanced project planner and proposal manager since 1976 of the General Electric Co.'s Gas Turbine Div., Schenectady, N.Y., has applied her expertness in thermal engineering to the solution of critical heat transfer and fluid flow problems. GE products resulting from her work range from IC packaging to steam turbine wheels. Fitzroy is editor of GE's *Heat Transfer and Fluid Flow Design Data Book,* reviewer for ASME's *Journal of Heat Transfer,* and holder of two patents. She began her career with GE in 1950 as an assistant development engineer in GE's Knolls Atomic Power Laboratory. Equipped with a BChE from Rensselaer Polytechnic Institute, Troy, N.Y., Fitzroy helped design shielding for nuclear power plants for submarines. After work as a heat transfer engineer in GE's Corporate Research and Development Center, she became manager in 1970 of that center's heat transfer consulting. Within four years she was promoted to strategy planner there. Her memberships include AIChE, NSPE, and SWE, from which she received the Achievement Award. She has served on the National Academy of Engineering's Board on Engineering Manpower, and on the NSF's Advisory


TOUMA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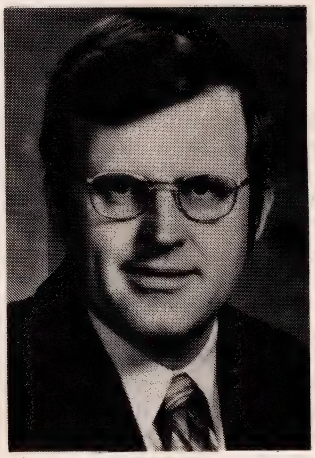
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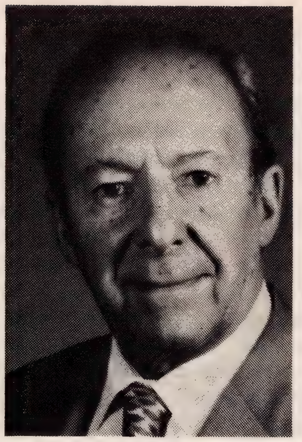
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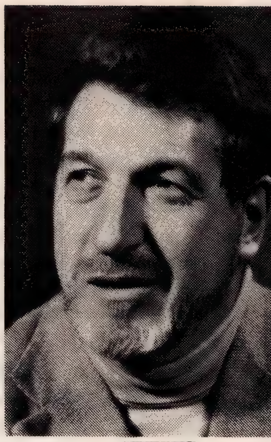

RABINS

Committee on Research. Recent ASME activities include membership on the National Nominating Committee (1977–1978), on the Policy Board, Professional and Public Affairs (1977–1980), and on the Policy Board, Education (1974–1978). Fitzroy is the first woman to be elected to the office of vice president within ASME.

General Engineering Department

George Fried, vice president since 1969, engineering and manufacturing, Manostat Corp., New York, N.Y., has complete responsibility for the corporation's laboratory equipment and scientific apparatus, from the research phase to field service. Previously, he worked at the American Machine and Foundry Co., where he designed bowling products and other automatic machinery. Fried obtained an M.S. in industrial and management engineering at New York University, New York City, in 1960. Since then Fried has accumulated 11 U.S. and foreign patents; his multichannel pump was described in *Bio-Medical Insight* as an "innovation in paristatic pumps that will be hard to beat." Fried is serving a second consecutive term of office as vice president of the General Engineering Department, is a member of ASME's Energy Policy Committee, and was a representative of the Design Engineering Division to the Policy Board, General Engineering Department (1974–1979).

Research

Lewis D. Conta, engineer-in-residence, Engineering Societies Commission on Energy, Washington, D.C., has written many research papers on topics ranging from combustion and flame stability to advanced rocket fuels and energy conversion and conservation. Before taking up his present post, Conta taught at the University of Rhode Island in Kingston for nine years, holding such posts as dean of the college of engineering, professor of mechanical engineering, director of the University Energy Center, and director of the Division of Engineering Research and Development. After receiving B.S. and M.S. degrees from the University of Rochester, N.Y., in the mid 1930s, Conta joined his alma mater's faculty as an instructor in mechanical engineering. In 1937 he began what was to become a nine-year tenure at Cornell as an assistant professor — a tenure culminating in a Ph.D. He returned to the University of Rochester in 1948 to chair the school's Division of Engineering. He served as program director for the National Science Foundation's Division of Engineering from 1967 to 1969 and as a consultant to companies and government agencies. Conta, a P.E., and a recipient of the Providence Engineering Society's Freeman Award, belongs to five honor societies. Recent ASME activities include service as member-at-large, Policy Board, Research, since 1973, and as secretary, Diesel and Gas Engine Power Division, since 1975.

Power Department

James R. Jones has been, since last year, vice president of environmental affairs, Peabody Coal Co., Fairview Heights, Ill. He graduated from Purdue University in 1942 with a BSME and immediately joined the Goodyear Aircraft Corp., Akron, Ohio. While at Goodyear he advanced from draftsman, working on the general design of aircraft, to assistant, to engineer coordinator, to group leader in administrative engineering. In 1945 he took charge of engineering, planning, and cost control until he joined the Northern Illinois Coal Corp. in 1946, and later Jones spent five years as a combustion engineer with the Southern Coal Co.—both of these companies were precursors of Peabody. At Peabody's St. Louis, Mo., office, Jones rose to director of environmental quality. Jones is a member of ASTM, and a former member of the Air Pollution Control Association as well as of the Task Force for Sulfur Dioxide Control Technology. He currently chairs the Environmental Matters Committee of the American Mining Congress and is on the National Coal Association's Water Quality Committee. Recent ASME activities include vice presidency of the Power Department last term; membership on the Committee on Staff (1980–1981); membership on the Policy Board, Member Interests and Development (1974–1977); and chairmanship of the National Membership Development Committee (1971–1977).

Communications

Michael J. Rabins, Fellow ASME, P.E., chairman, Mechanical Engineering Dept., Wayne State University, Detroit, Mich., since 1977, has investigated mechanical friction phenomena, nonlinear feedback control systems, dynamic mechanical systems, and automatic control system compensator synthesis. Author or co-author of over 23 papers and three books, and editor of a freshman's guide called *Introduction to Engineering,* Rabins holds two patents. He was educated at MIT, Carnegie Institute of Technology, Pittsburgh, Pa., and the University of Wisconsin, Madison, where he earned a Ph.D. in 1959. Rabins has taught at the University of Wisconsin, New York University, Carnegie, the Polytechnic Institute of Brooklyn, N.Y., and Wayne State. He has gained industrial experience at Republic Aviation Corp., Farmingdale, N.Y., IBM, Poughkeepsie, N.Y., and Bell Telephone Laboratories, Murray Hill, N.J., has consulted for companies such as Fairbanks Morse and Singer-General Precision, and was evaluation panelist for the National Science Foundation. Within the Society Rabins has been a member-at-large, Policy Board, Communications, since 1977, that board's Meetings Committee chairman from 1977 to 1978, and liaison to the Policy Board, Communications, for the Basic Engineering Department. He also chaired ASME's Automatic Control Division from 1976 to 1977.

Gas Turbine Conference Set for Texas

Houston, Tex., will host this year's International Gas Turbine Conference, sponsored by ASME's Gas Turbine Division. The conference, which will be held at the Albert Thomas Convention Center, Mar. 8–12, 1981, promises a high level of overseas participation.

In addition to the 85 technical sessions that are planned, a special forum on the new ANSI B133 Gas Turbine Procurement Standard will be held, which should be of interest to both manufacturers and users.

The broad spectrum of subject areas addressed by authors is reflected in the 39 design and component-technology-related sessions collectively planned by the Ceramics Combustion and Fuels, Controls, Heat Transfer, Manufacturing, Structures and Dynamics, and Turbomachinery Committees, as well as in some 43 systems and applications sessions planned by such committees as Aircraft, Closed Cycles, Coal Utilization, Electric Utilities, Marine, Process Industries, Pipeline Applications, and Vehicular. Also, three sessions are slated by the Education and Technology Resources Committees.

With a third of the technical program user-oriented, many offerings will address such contemporary concerns as cost of ownership, enhanced durability, procurement standards, alternative fuel capability, emissions, and total energy systems concepts. The bulk of the papers, however, continue to reflect traditional concerns such as component performance, analytical/experimental methodology, and design verification.

The six short courses offered this year are Compact Heat Exchangers, Blade Design Development and Field Experience, Foundations of Axial Turbomachinery Aerodynamics, Introduction to the Gas Turbine, and Turbomachinery Erosion and Performance Deterioration.

For more information contact: Paul Santella, ASME Headquarters; (212) 644-7793.

Society Receives Generous Gift from Honda Motors

The Honda Motor Co. has donated $100,000 to ASME to be used as an unrestricted gift. The Society has designated this gift as the "Honda Award Fund," to be placed in the Awards and Endowment Fund. The earnings of the fund will be used as Council may direct. Upon recommendation of the International Affairs Committee and the Committee on Honors, the proposal for this gift was accepted at the Executive Council Committee Meeting on Oct. 29, 1980.

SI Facts: Humidity (Relative)

It isn't the heat, it's the humidity. This is the complaint often heard on a hot day when the humidity is high. The humidity referred to here is relative humidity, and it is expressed as a percentage. In technical language, percentage relative humidity is defined as the partial pressure of water vapor in the air divided by the vapor pressure of water at the temperature of the air. In everyday language, the definition is the quantity of water in the air divided by the maximum quantity of water the air can hold at a given temperature. High relative humidity on a warm day causes discomfort because it offers resistance to and therefore reduces the rate of the evaporation of perspiration.

Problem: What is the relative humidity of 20°C air in which the partial pressure of the water vapor is 1.82 kPa?

Solution: Note that the vapor pressure of water at 20°C is 2.336 kPa.

$$\text{Relative humidity} = \frac{1.82\ \text{kPa}}{2.336\ \text{kPa}} \times 100 = 77.9\ \text{percent}$$

This series on SI terminology, written by Oscar Fisher, ASME Metric Study Committee, will help you master the metric system. ▪ Card Size: 176 x 125 mm

Call for Papers

Design Automation Conference

The Design Automation Committee of ASME's Design Engineering Division solicits papers for the Sixth ASME Design Automation Conference, which will be held in Hartford, Conn., at the Sheraton-Hartford Hotel, Sept. 20–23, 1981.

Papers are solicited in the broad areas of design and automation, including: man-machine interaction; computer graphics and drafting; optimization and numerical methods; mechanical design applications, including social, economic, and legal aspects; CAD/CAM systems; hardware/software system evaluation; finite element analysis; and intelligent machines and robotics. Papers related to any aspect of the theory or application of optimization to the design of mechanical systems are welcome.

This year papers concerning the current and future role of mini- and microcomputers in design and manufacturing are particularly encouraged, as are papers dealing with intelligent machines and robotics, and finite element analysis (especially nonstructural application areas).

Please send the original and four copies of your papers before *Mar. 1, 1981* to the appropriate review chairman: Industrial—Dr. Ronald R. Root, 2G5/651, IBM Corp., Hwy. 52 and 37th St., NW, Rochester, Minn. 55901; (507) 286-0579; Academic—Dr. Roger W. Mayne, Mech. Engrg., SUNY at Buffalo, Buffalo, N.Y. 14260; (716) 636-2734.

Suggestions concerning session and/or panel discussion topics or organization, and expressions of interest in papers review should be forwarded to one of the foregoing or to the committee chairman: Prof. K. M. Ragsdell, School of Mech. Engrg., Purdue Univ., West Lafayette, Ind. 47907; (317) 493-9815.

Fourth World Energy Engineering Congress

The Fourth World Energy Engineering Congress will be held Oct. 12–15, 1981, at the Georgia World Congress Center, Atlanta, Ga. Papers are now being accepted for presentation at the Congress. To be considered, send a one-page abstract including title, name of individual presenting paper, and address to: Fourth World Energy Engineering Congress, 4025 Pleasantdale Rd., Suite 340, Atlanta, Ga. 30340, by *March 1981.*

Sessions will be included on: low-, medium-, and high-temperature heat recovery, advanced energy engineering, products and applications, energy utilization — chemical and petroleum industries, glass industry, foundries, food industry, pulp and paper industry, textile industry, successful solar energy solutions, energy management, energy economics and rate structure, building and industry modeling and simulation, HVAC control system optimization, building energy performance standards, and building energy utilization. Additional subjects may be suggested.

1981 Advances in Bioengineering

The Bioengineering Division of ASME will be pleased to receive original abstracts for publication and presentation at the ASME Winter Annual Meeting, to be held Nov. 15–20, 1981, at the Sheraton Park Hotel in Washington, D.C. Although the theme of this meeting focuses on the effect of government and regulations on the engineer, all forms of original bioengineering work will be accepted in the areas of biofluid and biosolid mechanics, bioheat and mass transfer, instrumentation and controls, rehabilitation engineering, medical devices and standards, biomechanics of sport, and industrial applications of bioengineering. Technical sessions will include invited keynote lectures by recognized scientists and bioengineers.

Authors are encouraged to submit manuscripts in compact format on author-prepared mats limited to two pages of text and two pages of figures. Accepted abstracts will be published in *1981 Advances in Bioengineering.* Authors may write or call for guidelines and abstract mats to: David C. Viano, Ph.D., Biomedical Sci. Dept., General Motors Research Labs, Warren, Mich., 48090. Deadline for receipt of completed abstracts is *June 1, 1981.*

Aero-Thermodynamics of Steam Turbines

The Turbomachinery Committee of ASME's Gas Turbine Division and the Turbines and Related Auxiliaries Committee of the Power Division are planning a jointly sponsored Symposium on the Aero-Thermodynamics of Steam Turbines for the 1981 ASME Winter Annual Meeting, to be held in Washington, D.C., Nov. 15–20, 1981.

Papers are solicited which deal with steam turbine problems as viewed from the aerodynamic and thermodynamic viewpoints. Papers may cover recent advances in experimental or analytic investigations of steam turbine thermal sciences technology. Particularly encouraged are papers describing the aerodynamic design and analysis of individual turbine elements with emphasis on the low-pressure turbine, as well as the overall performance characteristics of steam turbine systems.

Additonal sessions will deal with the analysis of unsteady aerodynamic forces in steam turbine blading, valving, and rotor systems as a function of design geometry, Mach number, and moisture content. The general topic of two-phase flow in nuclear as well as fossil turbines and the identification and control of the effects of moisture such as material erosion, moisture removal, and effect on thermal performance and mechanical reliability are of particular significance.

Prospective authors should submit an abstract and offer of a technical paper (green sheet) by *Mar. 1, 1981,* and the final manuscript for review by *May 1, 1981.* These should be directed to W. G. Steltz, Steam Turbine Generator Div., Mail Code N-207, Westinghouse Electric Corp., P.O. Box 9175, Philadelphia, Pa. 19113, or to A. Donaldson, Stearns-Rogers, Inc., P.O. Box 5888, Denver, Colo. 80217.

Papers not specifically identified with these topics but dealing with the thermal sciences as applied to steam turbine design, development, or research should also be submitted for inclusion in this symposium.

Exportation of Unsafe Product or Hazardous Substances

The Technology and Society Division of ASME is sponsoring a session at the 1981 WAM in November on the Exportation of Unsafe Products or Hazardous Substances. The Division is soliciting abstracts on any aspect of this area either for written papers to be presented, or for oral presentation only.

Abstracts of 200 words or less should be sent to Robert S. Hattersley, P.E., Proctor and Gamble Co., International Div., 6060 Center Hill Rd., Cincinnati, Ohio 45224, no later than *Feb. 15, 1981.* Authors will be advised of acceptability by Mar. 15. Those who submit manuscripts will be required to send them in by *Apr. 30.* Acceptable papers may be published as ASME papers, be published in the *Journal of Engineering for Industry,* or be part of a collection of papers in a bound volume.

Information Transfer/ Technology Transition

ASME's Technology and Society Division and the Management Division are cosponsoring a session at the ASME Winter Annual Meeting in November 1981 called Information Transfer/Technology Transition. It will address the interface between the research, exploratory development, advanced development, manufacturing, and production units of an organization and the continuing flow required to realize optimum benefits from research in the production process.

There is a need for new and improved techniques to ensure that: new technology is made available to the ultimate user — production; the R&D facilities know what the technology needs are in the manufacturing/production facilities; the full cycle is completed and flow is in both directions; and the government and industry sectors are involved in productive discussions.

continued

Papers are solicited in these or related areas. Emphasis should be on means by which increased and improved information transfer/technology transition can be realized. Acceptable papers will be published in a bound volume, separately as an ASME reprint, or in an appropriate journal. If response indicates enough interest, a panel session may be arranged.

Prospective authors and panel members are invited to submit abstracts of proposed papers by *Mar. 15, 1981* to: Clark E. Beck, P.E.; AFWAL/FIBTC; Wright-Patterson AFB, Ohio 45433; (513) 255-2274. Abstracts should be between 200 and 500 words in length with an indication of the type of presentation (paper with presentation or panel participant) and author(s) name(s), organization, address, and phone number. Full manuscripts will be required no later than *June 1, 1981*. Submitters of accepted abstracts will be notified by Apr. 7, 1981.

Heat Exchanger Analysis Methods

The ASME Nuclear Engineering Division, Nuclear Heat Exchanger Committee plans to sponsor a technical session on Heat Exchanger Analysis Methods at the 1981 WAM, Nov, 15–20, 1981. The purpose of this session is to bring together the experience of heat exchanger industry and the methodology of nuclear heat exchanger development. Papers from both industry and academia are solicited.

Paper are invited on thermal hydraulic advances on and applications to: conventional and nuclear heat exchangers, vapor generators, condensers, and reheaters, with original contributions to the overall or local modeling, computational methods, validation of methods, or others aspects, for both heat transfer and fluid flow fields. Methods of multitube analysis, shell-side flow distribution, pressure drops, bundle temperature distribution, two-phase flow instability, transient analysis, etc. are highly desired. The material presented should be nonproprietary. Please call session organizers for further information.

Interested authors are requested to follow this schedule: abstract (up to 500 words) due Feb. 1, 1981; acceptance of abstract notification by Feb. 15; and manuscript due for review by Mar. 15.

Abstracts and manuscripts may be sent to either: Prof. S. C. Yao, Dept. of Mech. Engrg., Carnegie-Mellon Univ., Pittsburgh, Pa. 15213, (412) 578-2508; or Dr. S. M. Cho, Foster Wheeler Energy Corp., 9 Peach Tree Hill Rd., Livingston, N.J. 07039, (201) 533-2209.

Fluid Control Systems

The Fluid Control Systems Panel of the Dynamic Systems and Control Division of ASME is planning sessions at the 1981 WAM. Of interest are papers relating to fluid control systems, components, sensors, interfaces, applications, and systems analysis. Of particular interest will be papers relating to microprocessor-based fluid control systems, hydraulic and pneumatic control systems, and inertial stabilization systems. A session and special publication on fluid transmission lines are also planned.

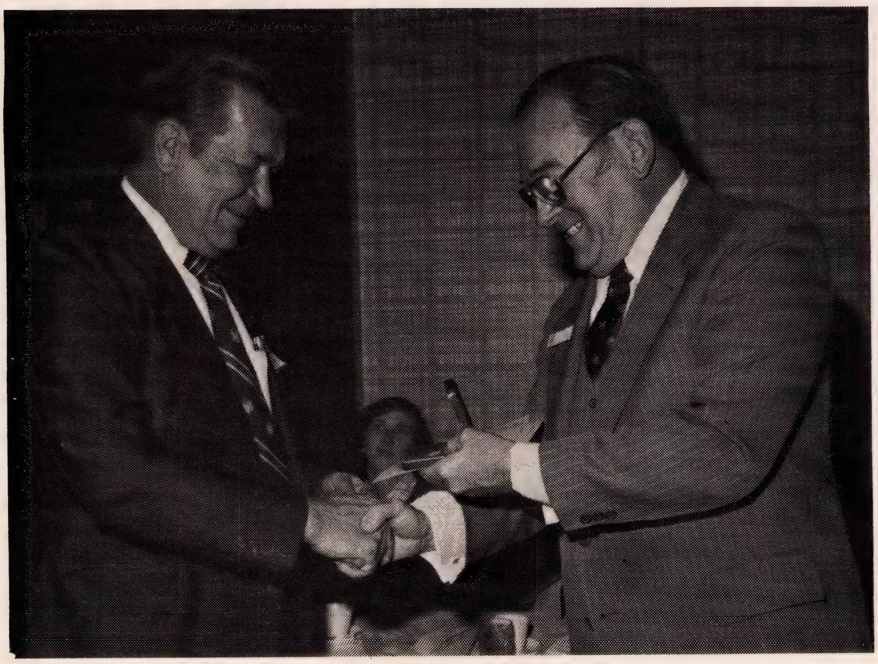
Papers should be submitted by *Mar. 1, 1981* to: Prof. J. Lowenshearer, Editor, *Journal of Dynamic Systems, Measurement and Control,* ME Bldg., Rm. 304, Penn State Univ., University Park, Pa. 16802.

Solar Energy Division Conference

In addition to the plenary sessions and over 100 technical papers that will be presented at this Solar Energy Division conference — the Third Annual Systems Simulation, Economic Analysis/Solar Heating and Cooling Operational Results Conference — several poster sessions are planned. Each presenter will have a space and time allotment to display and discuss his current work. The results presented may be incomplete, qualitative, or predictive, but the poster should not be used to advertise a particular product. Each author will be asked to prepare a one-page abstract of his/her poster and a booklet of these abstracts will be distributed to all registrants at the conference. The conference will be held at the MGM Grand Hotel, Reno, Nev., Apr. 27–May 1, 1981.

Authors should send a rough draft of their abstract to: Dr. Robert L. Reid, Mech. and Aerospace Engrg. Dept., Univ. of Tennessee, Knoxville, Tenn. 37916, (615) 974-4251, by *Mar. 1, 1981*. Accepted poster applicants will be provided with an ASME mat for final preparation of their abstract, to be due by *Apr. 1, 1981*.

Section & Region News



Ohio's CAM Section Honors Two

President Charles E. Jones, right, acknowleged the outstanding section and national efforts of Norm R. Johanson, left, of Alliance, Ohio, by presenting him with an ASME Centennial Medal at the Canton-Alliance-Massillon Section's Oct. 9 meeting. Jones, who gave a progress report of Centennial events, also presented James W. McConaghy of Ashland, Ohio, with an ASME 50-yr pin.

Meetings Calendar

asme coming events

1981

January 18–21
Energy-sources Technology Conference and Exhibition (ETCE), Houston, Tex.

March 9–12
Gas Turbine Conference and Products Show, Houston, Tex.

March 13–14
Technology Executives Conference, Hershey, Pa.

March 21–April 1
Lubrication Symposium, San Francisco, Calif.

April 6–10
Structures, Structural Dynamics and Materials Conference, Atlanta, Ga.

April 15–16
Joint Railroad Conference, Hyatt Regency, Atlanta, Ga.

April 27–29
American Power Conference, Palmer House, Chicago, Ill.

May 4–7
Offshore Technology Conference, participation by ASME, Astrohall, Houston, Tex.

May 18–21
Materials Conference, Hyatt-Regency, Dearborn, Mich.

June 1–4
Design Engineering Conference and Show, McCormick Place, Chicago, Ill.

June 14–17
Summer Annual Meeting (no technical sessions) MGM Grand Hotel, Reno, Nev.

June 17–19
Joint Automatic Control Conference, University of Virginia, Charlottesville, Va.

June 21–26
Pressure Vessels and Piping Conference, Denver Hilton, Denver, Colo.

June 22–24
Joint Meeting of ASME Fluids Engineering and Applied Mechanics Divisions, University of Colorado, Boulder, Colo.

July 13–15
Intersociety Conference on Environmental Systems, participation by ASME, Jack Tar Hotel, San Francisco, Calif.

August 2–5
Heat Transfer Conference, Marc Plaza Hotel, Milwaukee, Wis.

August 9–14
16th Intersociety Energy Conversion Engineering Conference, "Technologies for the Transition," Atlanta, Ga.

September 13–15
ASME Petroleum Division Conference and Workshop, Sheraton-Dallas, Dallas, Tex.

September 19–23
Engineering in Medicine and Biology, participation by ASME, Shamrock Hilton, Houston, Tex.

September 20–23
Design Engineering Technical Conferences, Sheraton-Hartford Hotel, Hartford, Conn.

October 4–7
Joint Lubrication Conference, International Hotel, New Orleans, La.

October 4–8
Joint Power Generation Conference, Sheraton-St. Louis Hotel, St. Louis, Mo.

October 18–21
Industrial Power Conference, Sheraton, St. Louis, Mo.

October 25–28
Management Executives Conference, The Cloister, Sea Island, Ga.

October 28–30
Eastern Design Engineering Show and Conference, New York Coliseum, N.Y.

November 15–20
ASME WINTER ANNUAL MEETING, Sheraton-Park Hotel, Washington, D.C.

December 9–11
Western Design Engineering Show, Anaheim Calif.

Note: Offers of ASME papers must be submitted seven months in advance of the meeting date (unless otherwise specified in "Call for Papers" notice). Persons wishing to prepare a paper for presentation at ASME national meetings or division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Conferences and Divisions Department, United Engineering Center, 345 East 47th Street, New York, N.Y. 10017. Price to nonmembers, 50 cents; to ASME members, free.

other coming events

1981

February 4
AIME, Eighth Automotive Materials Symposium, Detroit, Mich. Tel.: Richard Hammer (313) 575-2951

March 2–5
The American Society for Nondestructive Testing, Spring Conference and Tabletop Exhibits, Las Vegas, Nev. Tel.: (614) 488-7921

March 2–6
NACE, International Research Conference on High Temperature Corrosion, San Diego, Calif. Tel.: (713) 492-0535

March 3–5
Southern Plant Engineering and Maintenance Show and Conference, Atlanta, Ga. Tel.: (212) 661-8410.

March 5–6
TAPPI, Process Simulation Seminar, Chicago, Ill. Tel.: Janet Crane (404) 394-6130.

March 8–11
Third International Symposium on Pipelines, Philadelphia, Pa. Tel.: Prof. Iraj Zandi (215) 243-7244

March 9–11
Eighth Annual Energy Technology Conference and Exposition, Washington, D.C. Tel.: (301) 656-1090

March 9–12
Symposium on the Transfer and Utilization of Particulate Control Technology, Orlando, Fla. Tel.: Fred Venditti (303) 753-2241

March 10–11
28th Annual Western Safety Congress and Exhibits, Anaheim, Calif. Tel.: (213) 385-6461

March 11–13
1981 Particle Accelerator Conference—Accelerator Engineering and Technology, Washington, D.C. Contact: S. Penner, Chairman, National Bureau of Standards, Washington, D.C.

March 16–18
AIEE, Industrial Managers' Seminar, New Orleans, La. Tel.: (404) 237-8202

March 16–19
Seventh Annual Research Symposium–Land Disposal of Municipal and Hazardous Solid Waste and Resource Recovery, Philadelphia, Pa. Tel.: (512) 684-5111

FOREIGN

March 7–22
International Study Mission to Japan on "Quality Circles." Contact: R. H. Choi, M.I.M., Director, Technology Transfer Institute, 60 E. 42nd St., Suite 1043, New York, N.Y. 10165. Tel.: (212) 682-0052

March 9–13
International Conference on Engineering Design, Rome, Italy. Contact: Prof. Ing. U. Pighini, c/o Istituto di Macchine e di Tecnologie Meccaniche, Universita di Roma, Via Eudossiana 18, 1-00184, Rome, Italy.

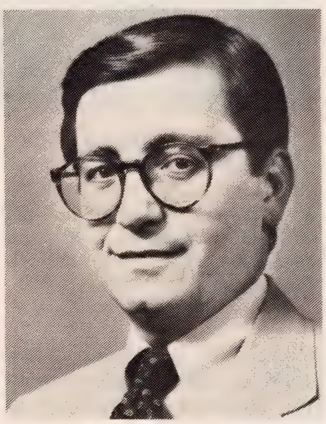
March 16–20
INSPEX '81, "Measurement and Inspection Technology Exhibition," Birmingham, U.K. Tel.: (212) 752-8400

March 17–20
TechEx '81 Europa, Ninth Annual World Fair for Technology Exchange, Vienna, Austria. Tel.: (904) 677-7033

March 24–27
Creep and Fracture of Engineering Materials and Structures, U.K. Contact: Dr. B. Wilshire, Applied Science Bldg., University College, Singleton Park, Swansea, SA2 8PP, U.K.

People in the News

Ken C. Hill, Assoc. Mem. ASME, has been named manager of marine and navy sales for the Worthington Pump Div. of McGraw-Edison Co., Mountainside, N.J.



Joseph P. Lahey, Mem. ASME, P.E., has joined the Pullman Kellogg Div. of Pullman, Inc., Houston, Tex., as manager of market planning.

William J. Lindblad, Mem. ASME, P.E., moves up from vice president of engineering and construction to president of the Portland General Electric Co., Portland, Ore.

Ernest T. Andalcio, Assoc. Mem. ASME, will hold a trusteeship, through mid-1983, of the New Jersey Institute of Technology's Alumni Association, Newark, N.J.

Carl Weissgerber, Mem. ASME, has been appointed to a new position as engineering manager at Goulds Pumps, Inc., Engineered Products Div., in Seneca Falls, N.Y.

William R. Tipton, Mem. ASME, is now vice president and general manager for all foreign and domestic products at the California Energy Co., Santa Rosa, Calif.

Walter B. Ingram, Mem. ASME, assumes the vice presidency of gas-compressor operations at the Frick Co., Waynesboro, Va. He was formerly manager of compressor engineering at Beloit Power Systems, Beloit, Wis.

Kenneth A. Rogers, Mem. ASME, P.E., takes on the roles of executive manager and program manager for the Engineering Societies' Commission on Energy, Inc., Washington, D.C. Rogers has 30 years of experience in process and plant design, cost estimating, and economic studies.

William H. Hopf, Mem. ASME, P.E., brings more than 16 years of experience in the valve industry to his new position as vice president and general manager of DEMCO, a division of Cooper Industries, Inc., Oklahoma City, Okla.

Paul K. Wright, Mem. ASME, assistant professor of mechanical engineering at Carnegie-Mellon University, Pittsburgh, Pa., has been selected one of five Outstanding Young Manufacturing Engineers for 1981 by SME. Author of over 40 articles and reports, Wright heads the automated machining laboratory within Carnegie-Mellon's Robotics Institute and is developing strain sensors for robots used in machining and for computer-controlled machine tools.

William C. Gallmeyer, president of the Gallmeyer and Livingston Co., Grand Rapids, Mich., has been elected first vice chairman of the National Machine Tool Builders' Association at its 79th annual meeting in Palm Beach, Fla.

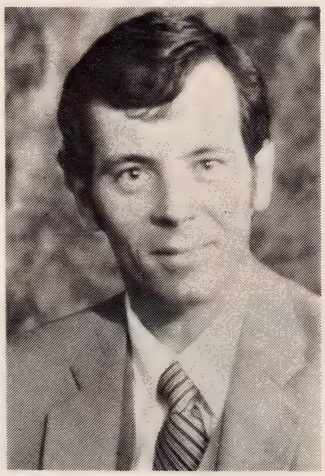
Winfred M. Phillips, Mem. ASME, associate dean for research at Pennsylvania State University, now heads Purdue University's School of Mechanical Engineering, West Lafayette, Ind. Recently, Phillips has focused his research on bioengineering and artificial internal organs.

Ronald J. Broglio, Mem. ASME, becomes vice president-engineering for Wheelabrator-Frye, Inc., Energy Systems Div., Hampton, N.H.

Song Fang Wu, Mem. ASME, P.E., has been appointed program manager of Foster Wheeler Solar Development Corp., Livingston, N.J.

Millard S. Pollock and **Andrew W. Wofford,** P.E., Mems. ASME, have been elected vice president—nuclear, and vice president—purchasing and stores, respectively, for the Long Island Lighting Co., Mineola, N.Y. Pollock will take charge of all operations related to the construction and operation of the Shoreham Nuclear Power Plant. Wofford's new responsibilities include the procurement of materials, including nuclear fuel and oil, and all equipment, supplies, and services.

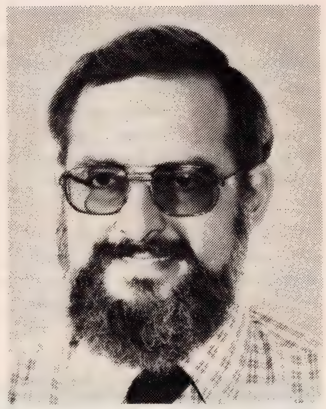
William Cooperman, Mem. ASME, is now manager of market development for Fiberglass Resources Corp., Farmingdale, N.Y. He will take charge of the development of new domestic and international markets for the company's products.



William D. Green, Assoc. Mem. ASME, has been appointed district sales manager for the Air Quality Control Group of Envirotech Corp., Coraopolis, Pa. Green will be responsible for the sale of products and systems of the Envirotech/Chemico, Buell, and Fluid-Ionic Systems Div. in the midwestern region.

Robert A. Golobic, Mem. ASME, P.E., is now manager of research and development for the Denver Equipment Div. of Joy Manufacturing Co., Colorado Springs, Colo.

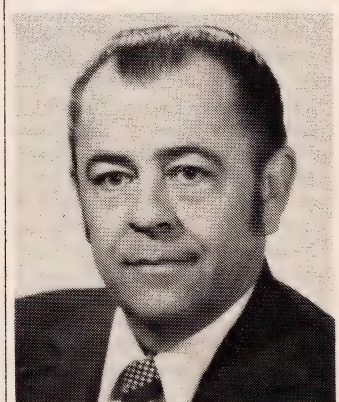
Ernest G. Cravalho, Mem. ASME, associate director, Whitaker College of Health Sciences, Technology, and Management, MIT, Boston, Mass., has been elected to the Institute of Medicine, National Academy of Sciences, Washington, D.C.



Joseph F. Marchese, Mem. ASME, is now manager of engineering for the Empire Abrasive Equipment Corp., Langhorne, Pa. Formerly, Marchese was a consulting engineer specializing in bulk materials handling systems.

Benjamin Gebhart, Fellow ASME, a leader in the field of convective heat transfer, has joined the faculty of the School of Engineering and Applied Science at the University of Pennsylvania, Philadelphia, Pa., as the first Samuel Landis Gabel Professor of Mechanical Engineering.

Jeffrey Hatman, Mem. ASME, formerly with General Electric's Advanced Energy Programs Div., has joined Ramada Energy Systems, Tempe, Ariz., as vice president of engineering.



Robert L. Vaughn, Fellow ASME, P.E., chief manufacturing engineer of the Space Systems Div., Lockheed Missiles and Space Co., Sunnyvale, Calif., was elected 1981–1982 president of the Society of Manufacturing Engineers at SME's recent semi-annual meeting in Chicago, Ill. Vaughn has been a member of SME's board of directors since 1972, serving as international secretary, treasurer, and vice president.

Roy E. Mondy, P.E., of Ingersoll-Rand Co., and **Paul E. Johnson** of Allis-Chalmers Corp., Assoc. Mems. ASME, won second and third prize, respectively, in the Compressed Air and Gas Institute's 1980 Technical Article Program competition. Mondy was awarded $750 for his article entitled "General Design and Analytical Considerations for Synchronous Motor Driven Equipment Trains," and Johnson received $500 for his article, "Sludge Gas Compressors in Water Waste Treatment Plants." A fourth prize of $250 went to **George R. Kent,** Mem. ASME, P.E., a consultant, for his article, "Criteria for Reciprocating Machine Reliability."

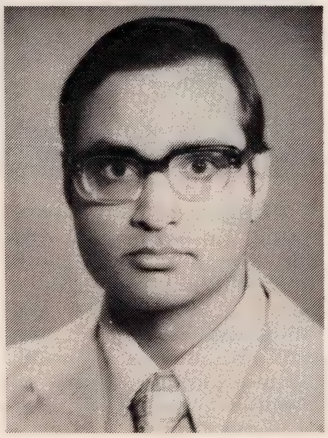
M. Eugene Merchant, Hon. Mem. ASME, a past vice president of the General Engineering Department of the Society, and, at present, director of research planning at Cincinnati Milacron, Inc., Cincinnati, Ohio, is the first recipient of the Georg-Schlesinger-Preis, an award established by the Senate of Berlin, West Germany, on the occasion of the 75th anniversary of the Institute of Machine Tools and Manufacturing Engineering of the Technical University of Berlin in July 1979. The award, named after the founder of the Institute, together with a prize of 10,000 West German marks, was presented to Merchant last October in the National Library in West Berlin by the senator for science and research, Peter Glotz, who read a testimonial address in honor of Merchant. Merchant himself gave a special talk on "World Trends in Advanced Machine Tool Development and Manufacturing Technology—in the Footsteps of Georg Schlesinger."

Merchant, who has served Cincinnati Milacron for over 40 years, is particularly noted for his role in introducing sociological questions into technological research—particularly in the area of computer-automated factories. He is a fellow of ASLE, served as that society's president from 1952 to 1953, and became an Honorary Member of ASME in 1971.

John A. Farris, Assoc. Mem. ASME, corporate director of Aerospace and Fluid Power Development, Pall Corp., New York, N.Y., received the National Fluid Power Association's 1980 Achievement Award at the association's fall conference last September in San Antonio, Tex. A pioneer in the concept of fine filtration, Farris was instrumental in converting the aircraft industry to silt control filtration of hydraulic fluid.

William A. Cox Jr., Mem. ASME, P.E., president of the Cox-Powell Corp., Norfolk, Va., assumed the presidency of the 80,000-member National Society of Professional Engineers last July during NSPE's annual meeting in Detroit, Mich. Cox is a founding and charter board member of the Virginia Society of Professional Engineers and has served as its president. He was named that society's "engineer of the year" in 1973 and on three occasions received its Outstanding and Distinguished Service Awards. In addition, Cox has been a vice president of the NSPE Southeastern Region.

Louis H. Roddis Jr., Fellow ASME, P.E., a consulting engineer and director for Gould, Inc. and Hammermill Paper Co., has been elected to the board of directors of Research-Cottrell, Inc. (AMEX), Somerville, N.J.



Vijay K. Garg, Mem. ASME, has been elevated to full professor from assistant professor at the Indian Institute of Technology, Kanpur, India.

Robert J. Eiber and **Raymond E. Mesloh,** Mems. ASME, P.E.'s, have been appointed manager of stress analysis and fracture research, and manager of a new electrical power technology research program office, respectively, at Batelle's Columbus Laboratories, Columbus, Ohio.

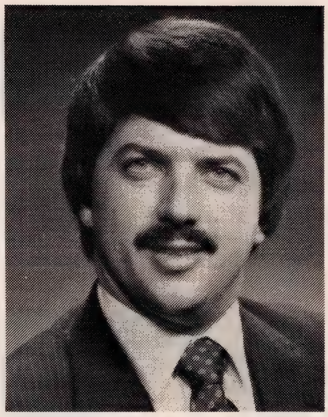
A. Salim Qureshi, Mem. ASME, P.E., has been appointed vice president and director of the Energy Management Group, Michael Baker Jr., Inc., New York, N.Y. Qureshi returns to Michael Baker after two years with Syska and Hennessy, Inc., the first year of which he served in Iran.

Warren R. Anderson, Mem. ASME, P.E., has been appointed executive vice president and general manager of the Cives Construction Co., Constructors Div., Waterville, Mass.

William R. Gould, Hon. Mem. ASME, P.E., chairman and chief executive officer of the Southern California Edison Co., has been elected a director of Beckman Instruments, Inc., Fullerton, Calif. Beckman manufactures analytical and industrial process instruments, specialty chemicals, and electronic components for medical, scientific, industrial, and environmental applications.

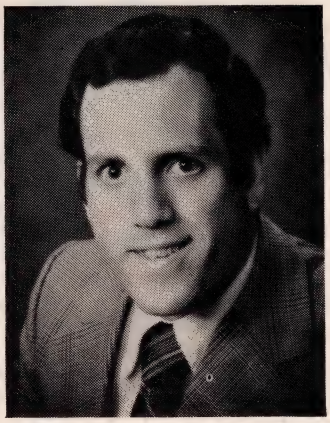
George B. Stanton Jr., Mem. ASME, P.E., of American Hazard Control Construction, Inc., Essex Falls, N.J., won first prize in the 1979–1980 Professional Paper Awards Competition, jointly sponsored by the Veterans of Safety and the American Society of Safety Engineers. The winning article, which appeared in the June, 1980, issue of *Professional Safety,* is entitled "Controlling Toxic Substances and Hazardous Materials."

Milton S. Plesset, Fellow ASME, and **Myer Bender,** Mem. ASME, have been appointed to the Advisory Committee on Reactor Safeguards of the Nuclear Regulatory Commission, Washington, D.C. Plesset, who becomes chairman, is professor emeritus, Dept. of the Engineering Science, California Institute of Technology, Pasadena, Calif. Bender is the director of the Engineering Div., Oak Ridge National Laboratory, Oak Ridge, Tenn.



Conny R. Brown, Mem. ASME, P.E., mechanical project engineer, Caudill Rowlett Scott, Inc., Architects, Planners, and Engineers, Houston, Tex., has been appointed a vice president of the company.

John H. Lienhard, Fellow ASME, a specialist in heat transfer, has joined the faculty of the University of Houston, Houston, Tex., as a full professor. Lienhard comes from the University of Kentucky in Lexington, where he has been a professor since 1967. Lienhard was a visiting professor at the University of Exeter, Devon, England, in 1975. Also joining the Mechanical Engineering Dept. this fall is **Aleksander S. Popel,** Mem. ASME, who comes from the University of Arizona, in Tucson, **Dean C. Winter,** Assoc. Mem. ASME, who comes from the College of Engineering and Applied Sciences at the State University of New York, Stony Brook, and **James Casey,** Assoc. Mem. ASME, who comes from the University of California at Berkeley. Within the University of Houston, **Isaak Kunin,** Mem. ASME, has been elevated to full professor of mechanical engineering.



Mitchell D. Garber, Assoc. Mem. ASME, now heads the Business Development Section of the Foster Wheeler Corporation's Contract Operations Div., Livingston, N.J.

Elections to Fellow Grade

ASME Members are honored with election to the grade of Fellow.

To qualify, a nominee must be an engineer with significant engineering achievements who, at the time of advancement, has attained the grade of Member and has had not less than 10 years of active practice following his or her first corporate membership in the Society. A proposal for promotion to Fellow must be initiated by a Fellow or Member of ASME. It must also be supported by at least four additional sponsors, two of whom must be ASME Fellows or Members, and then approved by the Council. The following were so honored for their outstanding contributions.

Lambert B. Freund, professor and recently appointed chairman of the Division of Engineering at Brown University, Providence, R.I., is a recognised authority in the fields of fracture and of guided elastic surface waves. His solution to the moving tensile crack problems that included, for the first time, nonconstant crack velocities is particularly noteworthy.

After receiving his Ph.D at Northwestern University in 1967, Freund started post-doctoral teaching at Brown, as a research fellow. By 1975, he had been appointed professor there, and had earned a reputation for both his dedicated teaching and his flair for recognizing the practical applications of his work, as evidenced by his research on pipeline fractures and the dynamics of earthquake rupture.

Freund has published over 50 technical papers and reviews. He is an active member of ASME's Applied Mechanics Division, of Sigma Xi, and the American Geophysical Union, and has served on ASTM's Organizing Committee. In 1974, he was honored with ASME's coveted Henry Hess Award.

David W. Lewis, P.E., professor in the Dept. of Mechanical and Aerospace Engineering at the University of Virginia, Charlottesville, is engaged in interdisciplinary teaching and research ranging from biomedical engineering to rotor dynamics. He has solicited and supervised research programs at the University of Virginia such as the development of the Rehabilitation Engineering Center and the Rotor Dynamics Experimental Test Facilities, which are supported by over 30 pump and compressor manufacturing and user companies. Lewis holds six patents, has published 36 articles, and has reviewed papers for several ASME Divisions.

Equipped with a doctorate from Northwestern University, Evanston, Ill., Lewis joined in 1960 IBM's General Products Div., Endicott, N.Y., where, as staff engineer, he developed several computer programs in dynamics and kinematics. His wide range of activities there included acting as in-company consultant on instrumentation and design, and conducting a dynamic analysis of a high-operational-rate reed switch. Three years later Lewis turned his mind toward the academic life when he took up the post he now holds at the University of Virginia. Among his many contributions to the university, he has developed an innovative general course on entrepreneurial engineering and has served as principal investigator and project director for a number of research programs, most recently the $319,000 Department of Energy program for the stabilization of essential rotating machinery for the fossil fuel industry. Lewis remained involved in the business world by founding and presiding over IDEAS, Inc., a small firm that builds special instruments for the tire manufacturing industry.

Apart from ASME, Lewis's other memberships include ASEE, Pi Tau Sigma, and Sigma Xi.

Van C. Mow, professor of mechanics, Dept. of Mechanical Engineering, Aeronautical Engineering, and Mechanics, Rensselaer Polytechnic Institute, Troy, N.Y., is an authority on orthopedic biomechanics, in particular, the medical properties of articular cartilage, the lubrication mechanism of synovial joints, and the biomechanical modeling of joint articulations. To Mow's credit are over 80 publications and over 100 invited lectures at such universities as Princeton, Cornell, the University of Zurich, Switzerland, and the University of Leeds, England. He is a member of the board of consulting editors for the *Journal of Bone and Joint Surgery* and is an associate editor for ASME's *Journal of Biomechanical Engineering.*

A Ph.D. in mechanics from Rensselaer Polytechnic, Mow taught for one year at Rensselaer before serving in 1967 as a visiting member in the Div. of Electromagnetic Research Courant Institute of Mathematical Research. After conducting research on waves of stratified fluid and ocean acoustics at Bell Telephone Laboratories, Mow returned to Rensselaer in 1969 as associate professor. Having consulted on biophysics for Harvard Medical School's Orthopedics Research Laboratory, Boston, Mass., he took a year's sabbatical in 1976 to help establish and expand a biomechanics research program. Mow became a full professor at Rensselaer in 1976, has served as visiting professor of biomechanics at the Mayo Clinic and as an adjunct professor of surgery at Albany Medical College since 1977, and has lectured on orthopedics at Harvard Medical School since 1978.

Mow chaired the program Committee of the Orthopedic Research Society, and chairs the Program Committee of ASME's Bioengineering Division, and the First Gordon Research Conference on Bioengineering and Orthopedics.

Herbert A. Pohto, senior engineer with the Union Carbide Corp., Nuclear Div. Y-12, Oak Ridge, Tenn., is an authority on high-pressure engineering and was responsible for the first comprehensive high pressure vessel rupture energy release tests resulting in design guidelines. Pohto, a P.E., holds two patents and is the author or co-author of over eight papers.

Pohto received a B.S. in mechanical engineering from Case Institute of Technology, Cleveland, Ohio, in 1943. He joined the Union Carbide Corp. in 1952 as a mechanical engineering section head and as principal engineer for uranium rolling and forming facility, the plant's nuclear propulsion fuel element production facility, and the high pressure isostatic pressing facility. As such, Pohto helped design unique systems for handling highly toxic hot uranium metals of large mass in production quantities. Twenty years later, he became the assistant to the project design manager of a $95 million production support facilities modernization and expansion project for the gaseous diffusion separation process at Union Carbide's Oak Ridge Gaseous Diffusion Plant. He took up his present position in 1975, since when he has prepared capital budget forecasts, detailed cost descriptions and justifications to support proposed nuclear weapon production projects. He has also conducted capital impact studies for "what if" alternatives and conceptual studies for new facilities, and has advised DOE's nationwide complex on high pressure technology.

Pohto was the first chairman of ASME's High Pressure Technology Subcommittee of the Pressure Vessel and Piping Division and a recipient of the Safety Award in Mechanical Engineering from Britain's Institution of Mechanical Engineers.

J. Lyell Sanders Jr., Gordon McKay Professor of Structural Mechanics at Harvard, has contributed to engineering mechanics through his evolution of accurate and usable theories of the deformation of shells, the development of plastic constitutive equations, and the treatment of stress concentration problems. Sanders has written over 15 major articles in the field.

By the time Sanders had received a Ph.D. in Applied Mathematics at Brown in 1954, he had already begun work at NACA, Langley Field, where he was head of the Elasticity and Plasticity Section. Since 1958—the year he was appointed to his present post—Sanders has continued work on shells, producing linear and nonlinear equations that have become standard and widely used for the past fifteen years.

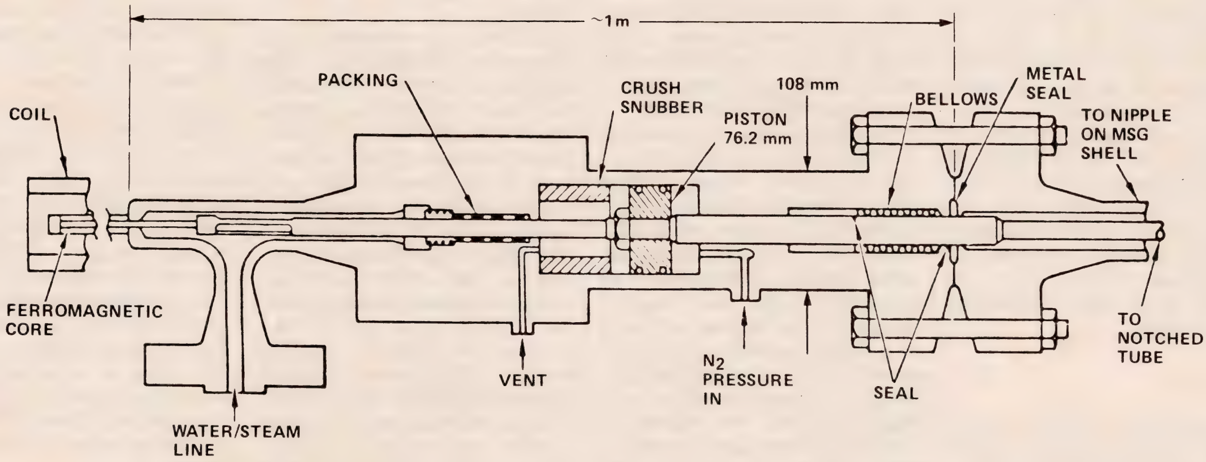
A member of ASME for 13 years, Sanders also belongs to the Society of Industrial and Applied Mathematics.

Technical Digest

Abstracts of ASME Meetings Papers • *Elizabeth Calvelli*

Nuclear Engineering

Papers presented at the ASME Winter Annual Meeting, November 16–21, 1980, are available to August 1981.



80-WA/NE-3 ■ Large leak injector device is a piston-cylinder device designed and fabricated by GE-ARSD. It is used to cause separation of the notched rupture tube.

80-WA/NE-1 ■ A PWR Secondary System Behavior for Postulated Pipe Rupture, by A. W. Chu, J. B. Mahoney, Mems. ASME, and M. Ramchandani, Burns and Roe Inc., Oradell, N.J.

The secondary system of a PWR plant was modeled on the RELAP4 Computer Code. A sensitivity study was undertaken on a simplified model to investigate different modeling techniques and program options. Hypothetical guillotine breaks were simulated in the mainstream and the feedwater lines.

The thermal hydraulic performance of the secondary system under these abnormal operating conditions was evaluated for safe shutdown of the plant.

80-WA/NE-2 ■ An Investigation of Small Break Loss-of-Coolant Phenomena in a Small Scale Nonnuclear Test Facility, by J. M. Cossuol, T. J. Fauble, and E. A. Harvego, EG&G Idaho, Inc., Idaho Falls, Idaho.

A small-scale nonnuclear integral test facility designed to simulate a pressurized water reactor (PWR) system was used to evaluate the effects of a small break loss-of-coolant accident (LOCA) on the system thermal-hydraulic response. The experiment approximated a 2.5-percent (11-cm-dia) communicative break in the cold leg of a PWR, and included initial conditions which were similar to conditions in a PWR operating at full power.

80-WA/NE-3 ■ U.S. Large Leak Sodium-Water Reaction Test Program, by J. C. Whipple, J. C. Amos, General Electric Co., Sunnyvale, Calif.; and H. H. Neely, Mem. ASME, Energy Technology Engineering Center, Santa Susana, Calif.

An extensive test program is under way in the U.S. to investigate the effects of large sodium-water reaction events in LMFBR steam generators. Tests were conducted in the large leak test rig located at the Energy Technology Engineering Center. The program was divided into two phases, Series I and Series II, for the purpose of satisfying near-term and long-term needs.

This paper defines the overall test program, describes the test articles and test facility, and summarizes the Series I test results.

80-WA/NE-4 ■ LDA Measurement of Droplet Behavior Across Tie Plate During Dispersed Flow Portion of LOCA Reflood, by S. L. Lee, J. Srinivasan, and S. K. Cho, State University of New York at Stony Brook, Stony Brook, N.Y.

The flow of an air-water droplet dispersion in a simulated 3-D test section in the reflood portion of LOCA was studied. For this purpose, a new scheme of laser-Doppler anemometry for the simultaneous measurement of size and velocity of large-size (0.5 mm-6 mm) droplets was developed and used.

In terms of droplet reentrainment from the tie plate, three flow regimes were identified, depending on the velocity level of the flow: the dome formation stage, the oscillating dome stage, and the wall film breaking up stage.

80-WA/NE-5 ■ Nuclear Power and Energy Uses, by B. Blumberg, General Electric Co., Sunnyvale, Calif.

Two basic steps that might eliminate the nation's reliance on Mideast oil are explored. The first is the substitution of electrically driven heat pumps for oil and gas residential and commercial space heating. This substitution is shown to be economically promising and would be an efficient use of indigenous energy resources.

The second is the elimination or reduction of oil and gas in the generation of electricity, much of which could be accomplished by accelerating the construction of the existing backlog of electrical generating plants. The paper then addresses the means of producing the resulting electricity demand and how nuclear power can be a significant factor in this scenario.

80-WA/NE-6 ■ The Role of Advanced Converters, by R. F. Turner and D. M. Lignon, General Atomic Co., San Diego, Calif.

Advanced converter reactors have been under development in the U.S. as systems which could conserve uranium resources and improve the economics of

nuclear energy. A longer-term application of advanced converters is to operate symbiotically with fast breeder reactors in a way that conserves fuel resources, yields favorable economics, offers means to limit proliferation of weapons materials and preserves alternatives for meeting increased energy demand.

A number of specific strategies for combinations of ACRs and FBRs are evaluated in this paper.

80-WA/NE-7 ■ Role of Advanced Reactors in Electricity Generation, by B. R. Sehgal, C. Braun, and A. Adamantiades, Electric Power Research Institute, Palo Alto, Calif.

The possible role of advanced conversion reactors (ACRs) in electricity generation is discussed. The relevance and importance of the various factors determining this is discussed. These include the uranium supply situation, the need for improving efficiency of uranium utilization, and the fuel cycle closure and diversion resistance.

Results of some recent studies on candidate concepts are described and the factors affecting commercialization of any one of these concepts are pointed out.

Corrosion and Deposits

Papers presented at the ASME Winter Annual Meeting, November 16–21, 1980, are available to August 1981.

80-WA/CD-1 ■ An Assessment of Deposition in PFBC Power Plant Turbines, by R. A. Wenglarz, Westinghouse R&D Center, Pittsburgh, Pa. (To be published in Trans. ASME—J. of Engrg. for Pwr.)

Using turbine deposition models and data from PFBC (pressurized fluidized bed combustion) pilot plant/cascade experiments, deposit buildup rates and turbine maintenance intervals to remove deposits are projected for a PFBC power plant system. The power plant consists of a 10-atm PFB boiler with a matching 10:1 pressure ratio turbine and a gas cleanup system to remove particulates from combustor product gases before entering the turbine.

The effects on turbine deposition of three alternative particle cleanup systems are evaluated. Turbine deposit removal intervals to prevent excessive power drops due to deposition are found for the alternative gas cleanup systems.

80-WA/CD-2 ■ Superplants for Power Generation: A Way to Improve Coal Utilization, by A. H. Madjid, The Pennsylvania State University, University Park, Pa.

Conventional power plants cannot utilize coal efficiently because they make use of only about one third of the coal input. They should, therefore, gradually be phased out and supplanted by the proposed superplants which will utilize above 80 percent of the coal consumed.

This is accomplished by (1) upgrading the conventional steam power core with modern topping systems relating to air and fuel preheaters, hot air turbines, and magnetohydrodynamic generators; (2) making use of the reject heat for gasohol production and the growing of produce in hydroponic greenhouses; and (3) reclamation of nitrogen and sulfur chemicals from the effluent.

80-WA/CD-4 ■ Erosion-Corrosion in the Multisolids Fluidized Bed Combustor, Part II: Burning Coal With Limestone in a 14 × 25-In. Unit with Integral Boiler, by H. H. Krause and W. E. Berry, Battelle Memorial Institute, Columbus, Ohio.

Erosion-corrosion studies were made in the 14 × 25-in. (0.36 × 0.635-m), multisolids, fluidized-bed combustor (MS-FBC) to determine: (1) effects on a carbon steel steam-generating tube in the combustor, and (2) the performance of various alloys and coatings oriented either perpendicular or parallel to the combustor flow.

Metal wastage measurements and metallurgical examination of one of the boiler tubes operated for 660 hr showed that any surfaces which are not vertical or which are subjected to changes in flow direction erode rapidly and should be shielded.

80-WA/CD-3 ■ An Investigation of the Relationship Between Partial Pressure of SO_3 and the Corrosion Potential of In 738 in Na_2SO_4 Melts at 900°C, by M. J. Zetlmeisl and K. J. McCarthy, Petrolite Corp., St. Louis, Mo.

A pressurized electrochemical cell was developed to study the effect of SO_3 partial pressure on the corrosion potential of In 738 in molten Na_2SO_4. Typical experiments were performed at 4–7 atm (1 atm = 1.013×10^5 N/m^2).

Partial pressures of SO_3 were calculated from a spectrophotometric determination of the number of moles of SO_3 and approximations of the total number of moles of gas in the cell.

Pressure Vessels and Piping

Papers presented at the ASME Winter Annual Meeting, November 16–21, 1980, are available to August 1981.

80-WA/PVP-1 ■ A Double Summation Procedure for the Combination of Seismic Responses of Multiply-Excited Piping Systems, by C. Sundararajan, Mem. ASME, EDS Nuclear Inc., San Francisco, Calif.

The multiple response spectrum method of seismic analysis is becoming popular to analyze piping systems subjected to different excitations at different supports or support groups. In this method the maximum responses due to each excitation in each mode of vibration are calculated separately by the response spectrum method, and then the responses due to each excitation are combined suitably to obtain the total modal responses.

The current practice is to use either the square root of the sum of squares (SRSS) procedure or the absolute summation (ABSUM) procedure to combine these responses. Both the procedures are approximate, and the analyst has to choose one on the basis of his judgement as to the applicability of the procedure for the specific problem.

In this paper a more rational double summation procedure is derived, and the theoretical basis and approximations involved are discussed.

80-WA/PVP-2 ■ Dynamic Crack Propagation Analysis of the SEN Specimen by a Numerical Method, by M. Peri, University of Washington, Seattle, Wash.

Crack initiation and fast crack propagation in the SEN specimen are investigated within the two-dimensional linear elastic fracture mechanics con-

fines. The influence of the initial crack length and the initial loading (bluntness) are persued and the phenomenon of terminal velocity is studied.

The analysis is performed using the SMF2D code, which is based upon the simultaneous employment of both a stationary and a moving coordinate system, thus providing a continuous and smooth crack extension.

80-WA/PVP-4 ■ A Plastic Fracture Mechanics Prediction of Fracture Instability in a Circumferentially Cracked Pipe in Bending—Part II: Experimental Verification on a Type 304 Stainless Steel Pipe, by G. M. Wilkowski, A. Zahoor, Assoc. Mem. ASME, and M. F. Kanninen, Mem. ASME, Battelle, Columbus Laboratory, Columbus, Ohio.

The possibility of a pipe fracture emanating from a stress corrosion crack in the heat-affected zones of girth-welds in Type 304 stainless steel pipes was investigated. The J-resistance curve—tearing modulus parameter for the prediction of crack initiation, stable growth and fracture instability was employed.

In the actual experiment, the onset of fracture instability occurred beyond maximum load at an average stable crack growth of 16 to 19 mm (0.63 to 0.75 in.) at each tip.

80-WA/PVP-5 ■ Ductile Axial Crack Extension in Pipes, by A. F. Emery, A. S. Kobayashi, and W. J. Love, Mems. ASME, and M. Perl, University of Washington, Seattle, Wash.

Recent calculations and comparison with experimental results have suggested that the time history of the propagation of axial cracks in pressurized pipes made of very tough and very ductile steel may be determined by combining the crack tip opening angle fracture criterion with the calculated opening shape of a split ring.

These results were for pipes of uniform thickness and were based upon small deflection theory. This paper examines the effects of nonuniform wall thickness and of large deflection theory.

80-WA/PVP-6 ■ Further Numerical Studies on Dynamic Circumferential Crack Propagation in a Large Pipe, by H. Awaji, A. S. Kobayashi, A. F. Emery, W. J. Love, Mems. ASME, and B. L. Kistler, University of Washington, Seattle, Wash.

The results of this paper and the results of previous dynamic ductile circumferential crack propagation in the 18-in.-dia 316 stainless steel pipe suggest that crack propagation in the presence of large-scale yielding is controlled mainly by the rotary inertia of the two fracturing pipe segments.

Also, the results suggest that arrest of crack propagation in tough pipe material can be accomplished by restricting the rotation of pipe segments.

80-WA/PVP-3 ■ A Plastic Fracture Mechanics Prediction of Fracture Instability in a Circumferentially Cracked Pipe in Bending—Part I: J-Integral Analysis, A. Zahoor, Assoc. Mem. ASME, and M. F. Kanninen, Mem. ASME, Battelle Columbus Laboratories, Columbus, Ohio.

A method of evaluating the J-integral for a circumferentially cracked pipe in bending is proposed. The method allows a J-resistance curve to be evaluated directly from the load-displacement record obtained in a pipe fracture experiment. This method also permits an analysis for fracture instability in a circumferential crack growth using a J-resistance curve and the tearing modulus parameter.

The influence of the system compliance on fracture instability is discussed in conjunction with the latter application. The results suggest that a compliant piping system containing a crack can exhibit ductile fracture instability after some stable crack growth.

80-WA/PVP-7 ■ Delamination of Layered Cylindrical Shells Under Internal Pressure, by D. P. Updike and U. Yuceoglu, Lehigh University, Bethlehem, Pa.

An approximate analytical formulation of the delamination problem of an axisymmetric, infinitely long, anisotropic, two-layer cylindrical shell under internal pressure is considered. The analysis is based on a tenth-order shell theory. The thin adhesive layer joining the two shell elements is assumed to behave as a system of distributed compression-tension and shear springs.

The adhesive layer normal and shear stresses due to the internal pressure leakage into the delamination region are calculated and the numerical results are presented.

80-WA/PVP-8 ■ Dynamic Crack Propagation in Very Ductile Materials—The Influence of Inertia, by M. Perl, A. F. Emery, A. S. Kobayashi, and W. J. Love, Mems. ASME, University of Washington, Seattle, Wash.

The comparison of recent calculations for the propagation of axial cracks in pressurized pipes with experimental data suggest that the crack growth is governed by the inertia of the separating parts. In order to study the validity of this conclusion for other configurations, the basic problem of a tensile plate was analyzed and the results reported.

Fuels

Papers presented at the ASME Joint Power Generation Conference, Sept. 28–Oct. 2, 1980, are available to July 1981.

80-JPGC/Fu-1 ■ Chemically Induced Slagging to Improve Superheat/Reheat Temperature, by A. E. Kober, Apollo Technologies Inc., Whippany, N.J.

Optimum unit efficiency requires compatibility between boiler design and fuel characteristics. Burning coal with ash composition significantly different from that for which the unit was designed can adversely affect superheat and reheat steam temperatures, resulting in reduced boiler efficiency and availability.

The use of chemical technology to modify the slagging characteristics of coal ash has proven effective in solving this problem. Results achieved under actual operating conditions at the Winyah Station of Santee Cooper are presented.

80-JPGC/Fu-4 ■ The Effects of a Volatile Fireside Manganese Additive on Coal-Fired Utility Boiler Operation, by M. A. Gray, Assoc. Mem. ASME, American Electric Power Service Corp., Canton, Ohio.

Significant performance benefits were obtained with no adverse effects when a volatile organometallic manganese additive—methyl cyclopentadienyl manganese tricarbonyl (Ethyl® CI2)—was added to the coal-air mixture firing a 525-MW supercritical cyclone boiler at the rate of 20 g/ton coal.

The addition of CI2 eliminated acid particulate fallout and reduced pluggage and corrosion of the air preheater and slagging in the convective pass and upper primary furnace. In conjunction with cold-end ammonia injection, it reduced visible plume synergistically.

This paper describes the test details and operational experience as well as a hypothesis to explain the effects at such a low additive treat level.

80-JPGC/Fu-5 ■ Use of Freeze Conditioning Agents and a Thawing Product on Coal, by J. K. Kelley, E. W. Moorhouse, R. D. Kelly, and B. L. Tolot, P.E., The Detroit Edison Co., Detroit, Mich.

With the greater utilization of coal and coal fines, 3/8 inch × 0 (95 mm by 0), in the power generation industry, the handling properties of coal at the plant

site are more demanding because of the retention of moisture by coal. In year-round delivery of coal by rail cars, there is a need to have coal dumped easily from cars during the cold months.

This paper deals with the use of freeze conditioning agents and calcium chloride on coal.

80-JPGC/Fu-3 ■ The Use of Additives to Reduce Ash Fouling Problems in Lignite-Fired Boilers, by F. I. Honea, Mem. ASME, D. K. Rindt, U.S. Dept. of Energy, Grand Forks, N.D.; R. Middelton, Otter Tail Power Co., Fergus Falls, Minn.; and D. Roth, Basin Electric Power Corp., Stanton, N.D.

Additives to reduce ash fouling problems in lignite-fired, utility boilers have been evaluated in a research and pilot-scale furnace test program at the Grand Forks Energy Technology Center. Compounds which show promise to reduce the ash deposit strength include calcium, magnesium, and calcium alumina silicate (melilite) compounds.

The Otter Tail Power Co., and the Basin Electric Power Cooperative have also tested additives in lignite-fired power plants and have had some success with calcium compounds in pulverized-coal fired boilers. However, cyclone-fired boilers still present a problem and additional additives are being evaluated for these boilers.

80-JPGC/Fu-6 ■ Experience with In-Service Water Cleaning of Boiler Fireside Deposits, by J. E. Nelson and R. D. Koester, Diamond Power Specialty Co., Lancaster, Ohio.

The use of water as an aid in cleaning fireside boiler surfaces has long been a tool of the boiler operator. In recent years, the use of modified sootblowing equipment to apply water to these surfaces has been gaining acceptance.

This paper discusses experiences and developments in cleaning fireside deposits on furnace and boiler surfaces that cannot be readily controlled by normal sootblowing methods. Furnace wall cleaning with medium-travel water lances, and convection-pass cleaning with long-retractable water blowers, water oscillators, and/or water assist blowing equipment are discussed.

80-JPGC/Fu-2 ■ Refuse-Derived Fuels, by H. H. Krause, Columbus Laboratories, Columbus, Ohio.

The rationale for energy recovery from municipal refuse is discussed, and planning for future installations for this purpose is cited. The composition and energy content of bulk waste, shredded refuse, and pelletized material are compared. Potential problems encountered with refuse combustion in the areas of slagging, corrosion, and stack emissions are outlined.

Applied Mechanics

Papers presented at the ASME Winter Annual Meeting, November 16–21, 1980, are available to August 1981.

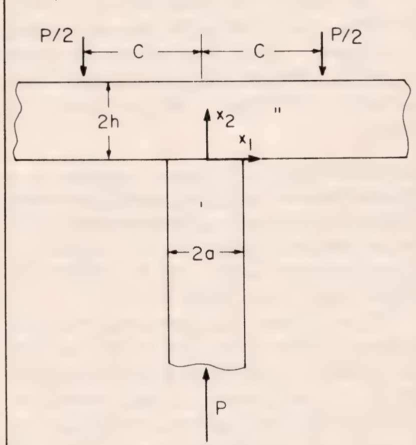
80-WA/APM-1 ■ An Application of Mixture Theory to Particulate Sedimentation, by D. C. Hill, A. Bedford, Mem. ASME, The University of Texas at Austin, Austin, Tex; and D. S. Drumheller, Sandia Laboratories, Albuquerque, N.M. (To be published in Trans. ASME—J. of Appl. Mech.)

Equations for two-phase flow are used to analyze the one-dimensional sedimentation of solid particles in a stationary container of liquid. A derivation of the equations of motion is presented which is based upon Hamilton's extended variational principle. The resulting equations contain diffusivity terms, which are linear in the gradient of the particle concentration.

80-WA/APM-2 ■ Experiments on Chaotic Motions of a Forced Nonlinear Oscillator: Strange Attractors, by F. C. Moon, Mem. ASME, Cornell University, Ithaca, N.Y. (To be published in Trans. ASME—J. of Appl. Mech.)

The forced vibrations of a buckled beam show nonperiodic, chaotic behavior for forced deterministic excitations. Using magnetic forces to buckle the beam, two and three stable equilibrium positions for the postbuckling state of the beam are found.

The deflection of the beam under nonlinear magnetic forces behaves statically as a butterfly catastrophe and dynamically as a strange attractor. The forced nonperiodic vibrations about these multiple equilibrium positions are studied experimentally using Poincare plots in the phase plane.



80-WA/APM-13 ■ A semi-infinite strip bonded to an infinite strip of different widths and material properties.

80-WA/APM-3 ■ Harmonic Wave Propagation in a Periodically Layered, Infinite Elastic Body: Plane Strain, Numerical Results, by T. J. Delph, G. Herrmann, Fellow ASME, Stanford University, Stanford, Calif.; and R. K. Kaul, State University of New York, Buffalo, N.Y. (To be published in Trans. ASME—J. of Appl. Mech.)

Numerical results are presented for the dispersion spectrum for harmonic wave propagation in an unbounded, periodically layered elastic body in a state of plane strain. Both real and complex branches are considered.

The spectrum is shown to be multiple-valued and quite intricate in detail. Some analytical properties of the Floquet surface are also discussed.

80-WA/APM-4 ■ An Application of the Poincare Map to the Stability of Nonlinear Normal Modes, by L. A. Month, University of California, Berkeley, Calif.; and R. H. Rand, Mem. ASME, Cornell University, Ithaca, N.Y. (To be published in Trans. ASME—J. of Appl. Mech.)

The stability of periodic motions (nonlinear normal modes) in a nonlinear two-degree-of-freedom Hamiltonian system is studied by deriving an approximation for the Poincare map via the Birkhoff-Gustavson canonical transformation.

This method is presented as an alternative to the usual linearized stability analysis based on Floquet theory. An example is given for which the Floquet theory approach fails to predict stability but for which the Poincare map approach succeeds.

80-WA/APM-5 ■ On the Influence of a Rigid Circular Inclusion on the Twisting and Shearing of a Shallow Spherical Shell, by E. Reissner, Fellow ASME, University of California at San Diego, La Jolla, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

Known results for plates with rigid inclusions are complemented by explicit asymptotic solutions of the corresponding problems for sufficiently thin spherical shells.

An important element of the analysis

is recognition of the fact that in addition to the distinction between interior and edge zone solution contributions there is a significant distinction between near-field and far-field behavior of the interior solution, with the nature of this distinction depending on the nature of the boundary conditions which are prescribed.

80-WA/APM-6 ■ Elastodynamic Analysis of an Edge Crack, by J. D. Achenbach, Fellow ASME, L. M. Keer, Mem. ASME, Northwestern University, Evanston, Ill.; and D. A. Mendelsohn, Halliburton Services, Duncan, Okla. (To be published in Trans. ASME—J. of Appl. Mech.)

This paper considers the elastodynamic stress-intensity factors generated by surface motion.

It is assumed that the faces of the crack do not interact with each other. Thus the crack never completely closes. This is a realistic assumption if the crack is actually a thin slit of finite width, or if a static prestress is applied which tends to hold the crack in an open position. In the latter case the solution sought in this paper is an elastodynamic perturbation (caused by time-harmonic surface motion) on this static prestress.

80-WA/APM-7 ■ Elastostatic Far-Field Behavior In a Layered Half Space Under Surface Pressure, by R. Muki, Mem. ASME and S. B. Dong, Mem. ASME, University of California, Los Angeles, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

This paper is concerned with far-field asymptotic expansions of displacements in an elastic half space with an elastic layer of possibly distinct mechanical properties. The analysis presupposes perfect bond between the semi-infinite medium and the layer, while the loading is confined to normal tractions applied to a bounded portion of an otherwise free surface of the layer.

80-WA/APM-8 ■ The Flow of a Non-Newtonian Fluid Past Projections and Depressions, by A. Mir-Mohamad-Sadegh, Assoc. Mem. ASME and K. R. Rajagopal, The University of Michigan, Ann Arbor, Mich. (To be published in Trans. ASME—J. of Appl. Mech.)

The plane flow of a homogenous incompressible second-order fluid past projections or depressions of arbitrary shape is considered. A numerical technique based on a boundary integral equation is developed and the problem of the flow past a rectangular slot of depth d and width w is solved.

80-WA/APM-9 ■ Fracture Criteria of Fibrous Laminated Composites Under In-Plane Multidirectional Loading, by J. Tirosh, Assoc. Mem. ASME, Technion—Israel Institute of Technology, Haifa, Israel; P. Mast, L. Beaubien, D. Mulville, S. Sutton, and I. Wolock, U.S. Naval Research Laboratory, Washington D.C. (To be published in Trans. ASME—J. of Appl. Mech.)

A study on the validity of various fracture criteria of angle-ply-laminated composites is presented for in-plane loading. Special emphasis is given to the vectorial presentation of the J-integral as a suitable candidate for fracture characterization of composites under general combined loading.

80-WA/APM-10 ■ Creep and Creep Recovery of 304 Stainless Steel Under Combined Stress With a Representation by a Viscous-Viscoelastic Model, by U.W. Cho, W. N. Findley, Fellow ASME, Brown University, Providence, R.I. (To be published in Trans. ASME—J. of Appl. Mech.)

Creep and creep-recovery data of 304 stainless steel are reported for experiments under constant combined tension and torsion at 593°C (1100°F). The data were represented by a viscous-viscoelastic model in which the strain was resolved into five components—elastic, plastic (time-independent), viscoelastic (time-dependent recoverable), and viscous (time-dependent nonrecoverable), which has separate positive and negative components.

80-WA/APM-11 ■ On the Unbonded Contact Between Plates and Layered Cylinders, by T. C. Soong and C. Li, Xerox Corp., Rochester, N.Y. (To be published in Trans. ASME—J. of Appl. Mech.)

An approximate solution is presented for the deflection of a thin plate and for the stresses and deformation of a layered circular cylinder in which the plate is pressed against the layered soft cylinder by a hard cylinder.

The contact is considered as frictionless, and the plate has an initial curvature. Since the load on the plate is radial and the initial curvature is arbitrary, nonlinear beam theory is used.

80-WA/APM-12 ■ Stress Analysis of a Penny-Shaped Crack Located Between Two Spherical Cavities in an Infinite Solid, by H. Hirai, Graduate Student, and M. Satake, Tohoku University, Japan. (To be published in Trans. ASME—J. of Appl. Mech.)

The problem of a penny-shaped crack located between two spherical cavities in an infinite solid subjected to uniaxial loads is considered. Using transformations between harmonic functions in cylindrical coordinates and those in spherical ones, the problem is reduced to nonhomogeneous linear equations.

80-WA/APM-15 ■ Nonlinear Corrections for Edge Bending of Shells, by G. V. Ranjan, Shelltech Associates, Stanford, Calif.; and C. R. Steele, Mem. ASME, Stanford University, Stanford, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

Asymptotic expansions for self-equilibrating edge loading are derived in terms of exponential functions, from which formulas for the stiffness and flexibility edge influence coefficients are obtained, which include the quadratic nonlinear terms.

The flexibility coefficients agree with those previously obtained by Van Dyke for the pressurized spherical shell and provide the generalization to general geometry and loading. In addition, the axial displacement is obtained.

80-WA/APM-13 ■ A Semi-Infinite Elastic Strip Bonded to an Infinite Strip, by G. G. Adams, Assoc. Mem. ASME, Northeastern University, Boston, Mass. (To be published in Trans. ASME—J. of Appl. Mech.)

The solution is obtained for the plane strain problem of a semi-infinite elastic strip whose end is bonded to and pressed against an infinite elastic strip. The infinite strip is supported by a pair of symmetrically located, concentrated forces. Using integral transform techniques, the solution is reduced to a set of singular integral equations of the second kind.

80-WA/APM-14 ■ A No-Slip Edge Crack on a Bimaterial Interface, by A. F. Mak and L. M. Keer, Mem. ASME, Northwestern University, Evanston, Ill. (To be published in Trans. ASME—J. of Appl. Mech.)

A solution for an interface edge crack whose surfaces experience no tangential slip is presented. At the crack tip, K_I is found to be identical to that for a surface crack in a homogeneous medium. Moreover, the shear stress is singular both at the surface and at the crack tip, with K_{II} at the crack tip being equal to $-\beta K_I$, where β is Dundurs' constant.

80-WA/APM-16 ■ On Torsion and Transverse Flexure of Orthotropic Elastic Plates, by E. Reissner, Fellow ASME, University of California at San Diego, La Jolla, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

The equations of transverse bending of shear-deformable plates are used for the derivation of a system of one-dimensional equations for beams with unsymmetrical cross section, with account for warping stiffness, in addition to bending, shearing, and twisting stiffness.

80-WA/APM-17 ■ Drawing of Tubes, by D. Durban, Technion—Israel Institute of Technology, Halfa, Israel. (To be published in Trans. ASME—J. of Appl. Mech.)

The process of the tube drawing between two rough conical walls is analyzed within the framework of continuum plasticity. Material behavior is modified as rigid/linear-hardening along with the von-Mises flow rule. Assuming a radial flow pattern and steady-state flow conditions, it becomes possible to obtain an exact solution for the stresses and velocity.

80-WA/APM-18 ■ A Nonlinear Theory of Viscoelasticity for Application to Elastomers, by R. M. Christensen, Fellow ASME, University of California, Livermore, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

A simple nonlinear theory of viscoelasticity has been developed for application to elastomers. The theory is the viscoelastic generalization of the kinetic theory of rubber elasticity, and it is used to model time and rate-dependent effects. The method of derivation reveals

that the theory is applicable to stress-imposed rather than strain-imposed conditions.

80-WA/APM-19 ■ Some Results on the Nature of Eigenvalues of Discrete Damped Linear Systems, by D. J. Inman, Assoc. Mem. ASME, State University of New York at Buffalo, Amherst, N.Y.; and A. N. Andry, Jr., Michigan State University, E. Lansing, Mich. (To be published in Trans. ASME—J. of Appl. Mech.)

An analysis of the conditions under which the modes of a damped linear lumped parameter system are either all critically damped, overdamped or underdamped is presented. These conditions are derived from the definiteness of certain combinations of the coefficient matrices.

80-WA/APM-20 ■ Vibrations of Solid Cylinders, by J. R. Hutchinson, Mem. ASME, University of California, Davis, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

A series solution of the general three-dimensional equations of linear elasticity is developed and used to find accurate natural frequencies for the vibrations of solid elastic cylinders with traction-free surfaces. The series solution is found to converge to accurate frequencies with the use of very few terms.

80-WA/APM-21 ■ A Thermomechanical Example of Auto-Oscillation, by Carl Panek, Ebasco Services Inc., New York, N.Y. (To be published in Trans. ASME—J. of Appl. Mech.)

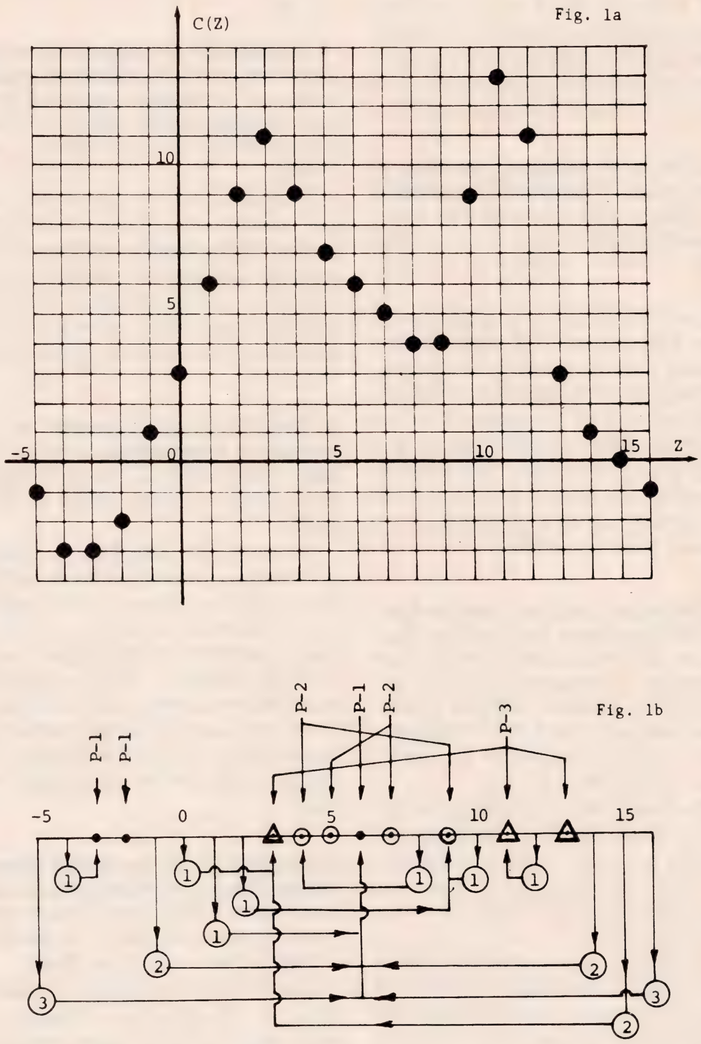
This paper examines a simple thermomechanical system for the existence of auto-oscillation, the system being a thin thermoelastic rod projecting from the warmer of two parallel right walls, their separation being slightly wider than the length of the rod.

It is found that given a physical configuration which excludes the two limit cases (intimate contact with the cooler wall and absolute noncontact with the cooler wall) either an oscillatory solution or a steady-state solution may develop.

80-WA/APM-27 ■ An Unravelling Algorithm for Global Analysis of Dynamical Systems: An Application of Cell-to-Cell Mappings, by C. S. Hsu and R. S. Guttalu, University of California, Berkeley, Calif. (To be published in Trans. ASME—J. Appl. Mech.)

A new method is offered here for global analysis of nonlinear dynamical systems. It is based upon the idea of constructing the associated cell-to-cell mappings for dynamical systems governed by point mappings or governed by ordinary differential equations.

The method uses an algorithm which allows us to determine in a very effective manner the equilibrium states, periodic motions and their domains of attraction when they are asymptotically stable. The theoretic base and the detail of the method are discussed and the potential of the method is demonstrated by several examples of application.



80-WA/APM-26 ■ Illustrative example of one-dimensional cell-to-cell mappings.

80-WA/APM-26 ■ A Theory of Cell-To-Cell Mapping Dynamical Systems, by C. S. Hsu, University of California, Berkeley, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

In this paper an introductory theory of cell-to-cell mappings is offered. In the first half of the paper the analysis of cell-to-cell mappings is discussed.

In the second half the cell-to-cell mappings which are obtained from point-to-point mappings by discretization are examined in order to see what properties of the point mapping systems are preserved in the discretization process.

80-WA/APM-24 ■ On The Uniqueness and Stability of Endochronic Theory, by B. J. Hsieh, Mem. ASME, Argonne National Laboratory, Argonne, Ill. (To be published in Trans. ASME—J. of Appl. Mech.)

Several numerical and analytical analyses are described which evaluate the uniqueness and stability of solutions of mechanical models whose material behaviors are governed by the endochronic theory of plasticity. It is shown that the endochronic solution is at least as unique as that of the elastoplastic theory.

80-WA/APM-30 ■ Parametric Resonance Oscillations of Flexible Slender Cylinders in Harmonically Perturbed Axial Flow—Part I: Theory, by M. P. Paidoussis, Mem. ASME, N.T. Issid, and M. Tsui, McGill University, Montreal, Quebec, Canada. (To be published in Trans. ASME—J. of Appl. Mech.)

This paper studies theoretically the dynamical behavior of a flexible slender cylinder in pulsating axial flow. The dynamics of the system in steady, unperturbed flow are examined first. For various sets of boundary conditions the eigenfrequencies of the system at any given flow velocity are determined, and the critical flow velocities are established, beyond which buckling (divergence) would occur.

The behavior of the system in pulsating flow is examined next, establish-

ing the existence of parametric resonances. The effects of the mean flow velocity, boundary conditions, dissipative forces, and virtual (hydrodynamic) mass on the extent of the parametric instability zones are then discussed.

80-WA/APM-22 ■ Multiple Scattering of Waves in Irregularly Laminated Composites, by R. L. Weaver and Yih-Hsing Pao, Mem. ASME, Cornell University, Ithaca, N.Y. (To be published in Trans. ASME—J. of Appl. Mech.)

The transition matrix formulation of multiple scattering is applied to the problem of wave propagation in a one-dimensional layered medium. The effect of geometrical irregularity in an otherwise periodic layered structure is investigated in detail for the case of elastic waves propagating normally to elastic layers embedded in elastic, or in viscoelastic matrix media.

80-WA/APM-28 ■ Vibrations of Rectangular Plates With Nonuniform Elastic Edge Supports, by A. W. Leissa, Mem. ASME, Ohio State University, Columbus, Ohio; P. A. A. Laura, and R. H. Gutierrez, Instituto de Mecánica Aplicada, Base Naval, Puerto Belgrano, Argentina. (To be published in Trans. ASME—J. of Appl. Mech.)

Two methods are introduced for the solution of free vibration problems of rectangular plates having nonuniform, elastic edge constraints, a class of problems having no previous solutions in the literature.

One method uses exact solutions in the governing differential equation of motion, and the other is an extension of the Ritz method. Numerical results are presented for problems having parabolically varying rotational constraints.

80-WA/APM-29 ■ Approximate Laplace Transform Inversion in Dynamic Viscoelasticity, by S. R. Swanson, Assoc. Mem. ASME, The University of Utah, Salt Lake City, Utah. (To be published in Trans. ASME—J. of Appl. Mech.)

The present work shows that one of the numerical Laplace transform inversion techniques of Bellman can successfully be applied to dynamic viscoelasticity. Comparisons with literature solutions and exact functions indicate accuracies to within ±1 percent can be obtained.

80-WA/APM-23 ■ Resolution of a Core Problem in Wound Rolls, by H. P. Yagoda, Mem. ASME, AMF Inc., Stamford, Conn. (To be published in Trans. ASME—J. of Appl. Mech.)

An explicit closed-form analytical solution is derived in terms of hypergeometric functions for the radial and circumferential stresses within rolls which may be wound under variable winding tension. With appropriately selected parameters, the solution holds for plane stress or plane strain conditions and for general winding configurations, i.e., center or surface-wound rolls.

80-WA/APM-32 ■ Asymptotic Integration Methods Applied to Rotating Beams, by C. R. Steele, Mem. ASME, and K. E. Barry, Stanford University, Stanford, Calif. (To be published in Trans. ASME—J. of Appl. Mech.)

The in-plane vibrational characteristics of an off-axis clamped beam subjected to either compressive or tensile forces arising from steady rotation are studied. The differential equations of motion are cast into state vector form and solved using asymptotic matrix integration methods. The general theory of these methods is described in this paper and their application to the analysis of rotating beams is made.

80-WA/APM-25 ■ Stability Considerations in Thermoelastic Contact, by J. R. Barber, University of Newcastle upon, Tyne, U.K.; J. Dundurs, Fellow ASME, Northwestern University, Evanston, Ill.; and M. Comninou, Mem. ASME, The University of Michigan, Ann Arbor, Mich. (To be published in Trans. ASME—J. of Appl. Mech.)

A simple one-dimensional model is described in which thermoelastic contact conditions give rise to nonuniqueness of solution. The stability of the various steady-state solutions discovered is investigated using a perturbation method.

80-WA/APM-31 ■ Parametric Resonance Oscillations of Flexible Slender Cylinders in Harmonically Perturbed Axial Flow—Part 2: Experiments, by M. P. Paidoussis, Mem. ASME, N.T. Issid, and M. Tsui, McGill University, Montreal, Quebec, Canada. (To be published in Trans. ASME—J. of Appl. Mech.)

This paper examines experimentally the dynamical behavior of a flexible slender cylinder in axial flow, perturbed harmonically in time. Parametric resonance oscillations were found to exist over certain ranges of frequencies and amplitudes of flow-velocity perturbations. The most prominent of the resonances, in these experiments, were associated with the second-mode principal primary resonance, and were studied extensively.

Management

Papers presented at the ASME Winter Annual Meeting, November 16–21, 1980 are available to September 1981.

80-WA/Mgt-2 ■ The Planning and Execution of Engineering Work in a Project Environment, by R. N. Sykes, Mem. ASME, Bechtel Power Corp., San Francisco, Calif.

Over the past few years, a great deal of attention has been paid to the development of the tools necessary for the management of large nuclear and fossil power plant projects. The size and complexity of these projects required that new techniques and tools be available to properly control the engineering, procurement, and construction to complete these projects on schedule and within budget.

This paper discusses some of the specialized tools that Bechtel has developed to help plan and execute the engineering work in a project environment.

80-WA/Mgt-3 ■ Technology Assessment: A Background Review, by C. B. Tatum, Mem. ASME, Ebasco Services Inc., New York, N.Y.; and R. A. Loth, Electric Power Research Institute, Palo Alto, Calif.

The potential for widespread implications of new technology has prompted interest in a means of evaluating consequences prior to implementation. Technology assessment fulfills this need. This paper describes the evolution of this process. The conceptual framework is first established. Background descriptions from three areas, the federal government, research and development organizations, and business and industry, are presented.

These descriptions include methodology, organization and applications. In the conclusions section, future applications of the technology assessment process are projected.

80-WA/Mgt-1 ■ The Theory and Practice of Management: Part Art, Part Science, by L. R. Bittel, Fellow ASME, James Madison University, Harrisonburg, Va.

This paper traces the basic history of management from its intuitive practitioners such as Towne, Ford, and Whitney to its creative engineering observers such as Taylor, the Gilbreths, and Gantt to the present group of theorists and synthesizers.

The paper concludes that the scientific approach continues to make management more systematic, rational, and effective, but that a large part of the field remains undisciplined and elusive.

80-WA/Mgt-4 ■ A Method for Evaluating the Relative Worth of Research and Development Tasks to Prioritize Them, by T. E. Hinton, Navy Materiel Command, Woodbridge, Va.

Existing methods of prioritizing research projects rely on subjective estimation of overall benefits and do not permit a weighting of contribution in subsidiary categories. A method is developed based on value engineering principles which permit assessment of values in more readily determined categories such as timeliness, response to strategy, etc.

A straightforward procedure is presented which includes the ability to assess relative importance of the subsidiary evaluation criteria.

80-WA/Mgt-5 ■ No Man Is an Island, by J. W. Coaker, Mem. ASME, Richmond Engineering Co., Richmond, Va.

The Three Mile Island incident in March 1979 had far-reaching ramifications and implications. Inherent in an analysis of information flow, media coverage and resulting public perception is a crucial message by example to the technical community, especially management.

This paper analyzes flow of information, media response and resulting public reaction, with the objective of focusing on those aspects of liaison between technical and nontechnical communities which stand to be significantly improved.

80-WA/Mgt-6 ■ Failure Analysis and Expert Witness for Products Liability—A Responsibility for the Engineering Profession, by J. M. Vance, Mem. ASME, Texas A&M University, College Station, Tex.; and R. W. Gould, University of Florida, Gainesville, Fla.

It is shown in this paper that the engineering profession is in a unique position to make a valuable contribution to justice in the present legal process by providing the required understanding of the complex technical factors involved in many product liability cases.

The special roles and requirements of the engineer in industry and the engineering professor in this process are described.

(More WA/Mgt digests in February ME.)

Safety Engineering

80-WA/Saf-1 ■ A Reliability Design and Catastrophic Failure Model for Exhaust Systems, by C. E. Dorgan and D. S. Ermer Mem. ASME, University of Wisconsin-Madison, Madison, Wis.

The objective of this paper is to show how reliability goals can be incorporated in the design of exhaust systems. The reliability model includes the procedures normally involved in the design of such systems, and the failure model is developed as a function of static pressure and volumetric flow rate.

The result is the probability that an installed system at startup can meet its functional requirement of providing enough volumetric air flow, such that contaminates within the workplace are kept below a specified maximum level. The approach is a departure from conventional reliability analyses, where models are based on statistical analysis of life testing data, with little or no input from the design or operating characteristics of the system.

Current Books

Vicki Koestler

Recent Additions to the Library

Space Transportation Systems (AIAA Aerospace Assessment Series, Vol. 1). Ed. by Robert Salkeld et al. American Inst. of Aeronautics and Astronautics, 1290 Ave. of the Americas, New York, N.Y. 10019. 91 pp., bound. $19.50. ISBN 0-915928-27-2.

During the development of the present partly reusable space shuttle by NASA in the 1970s, many fresh ideas and new technologies in space transportation began to appear which offered considerable promise for substantial cost reductions and revolutionary capabilities in the 1980–2000 era. These included wholly new vehicle concepts such as fully reusable single-stage-to-orbit transports; advanced chemical, electrical, and other propulsion technologies; low-mass vehicle structures; and highly efficient reusable thermal protection systems. This book presents an overview of these possibilities as they now appear. It documents the methods for meeting projected space transportation requirements, first by the present partly reusable shuttle and its current upper stages and later by reusable orbital transfer vehicles, shuttle uprating, fully reusable and single-stage transports, heavy-lift vehicles, and advanced vehicles for orbital transfer and lunar landing.

Solar Cell Array Design Handbook: The Principles and Technology of Photovoltaic Energy Conversion. By Hans S. Rauschenmach. 1980, Van Nostrand Reinhold, 135 W. 50 St., New York, N.Y. 10020. 549 pp., bound. $42.50. ISBN 0-442-26842-4.

Taking the user's point of view, this book brings together current information on solar cell array design for both terrestrial and space applications. Intended for both specialists and students, it gives a broad picture of solar cell array systems, and spells out in detail the latest technological data needed for the specification, design, fabrication, and testing of solar cell arrays. In addition to information on the overall design process, the reader will find treatment of: theoretical, physical, scientific, and engineering principles underlying solar array technology; uses of solar cell arrays; optical elements, including filters, coatings, and sunlight concentrator elements; electrical features with attention to solar cell interconnectors; mechanical characteristics at both assembly and component levels; techniques for fabrication process control; electrical, optical, and environmental test procedures; and design problems and how to deal with them. Also discussed in depth are the effects of the environment and the handling and transportation of solar arrays, as well as the general, mechanical, thermal, and electromagnetic properties of materials used in them. The appendices include extensive insolance tables, conversion factors and formulas, and an explanation of the basic mathematical principles involved.

Library Services

Members of ASME and nine other societies that maintain the Engineering Societies Library may borrow books in person or by mail. Of course, conference proceedings, journals, bibliographies, and other specialized reference items do not circulate. Many of these can be copied and forwarded upon request.

Requests for service or for further information about services and discounts to members should be addressed to the Engineering Societies Library, United Engineering Center, 345 East 47th Street, New York, N. Y. 10017.

Electric Automobiles: Energy, Environmental, and Economic Prospects for the Future. By William Hamilton. 1980, McGraw-Hill, 1221 Ave. of the Americas, New York, N.Y. 10020. 425 pp., bound. $24.50. ISBN 0-07-025735-3.

The object of this report is to present quantitative estimates of the benefits and costs to be expected from large-scale use of electric automobiles in the U.S. It is intended to support balanced decisions, not to advocate a particular policy about electric cars. In recognition of the many uncertainties about the future prospects of electric cars, it investigates a spectrum of possibilities rather than a single prediction for the future. In approaching the prospects for electric cars, this report starts by looking at the cars themselves: their capabilities, costs, and potential usage. After a review of today's state of the art that demonstrates the crucial importance of improved batteries, it projects characteristics of representative improved batteries for the future. The range, speed, energy requirements, and other characteristics of future electric cars are next estimated; in comparison with the actual driving requirements of motorists, they show the impressive extent to which the cars will be applicable to typical needs. The dollar costs of acquiring and operating electric cars are then projected and compared with the costs of competitive conventional automobiles. Thus, the principal impacts of electric cars on individual motorists are quantified: loss of mobility due primarily to the limited range of the electric car, plus higher costs stemming from the weight and expense of the propulsion battery. The report then turns to the societal benefits and costs of electric cars: their probable impacts on electric power generation, on energy and petroleum use, on environmental quality, on the economy, and on materials resources.

ASME Codes & Standards

Calls for Comment

Revisions to ANSI/ASME PVHO 1—1977

This standard provides minimum requirements for design, fabrication, inspection, testing, and stamping of pressure vessels for human occupancy which are intended to supplement the provisions of the ASME Boiler and Pressure Vessel Code. In particular, this standard provides rules for design and installation of acrylic viewports.

Order from Jerry D'Avanzo, PTCS, ASME, 345 E. 47th St., New York, N.Y. 10017. Single copy price is $3.00. Deadline for comment: Feb. 28, 1981.

ASME Committee on Operation and Maintenance of Nuclear Power Plant Components Proposed Standards

The following documents are being forwarded to ANSI for public review and comment. The review period will expire on Feb. 26, 1981.

1 "Requirements for Inservice Performance Testing of Nuclear Power Plant Pressure Relief Devices"

This standard provides requirements for periodic performance testing and monitoring of pressure relief devices in nuclear power plants. This standard establishes test intervals, test methods, data requirements, and criteria for evaluation of test results.

Price: $6.00.

2 "Requirements for Performance Testing of Nuclear Power Plant Closed Cooling Water System"

This standard provides system perfor-

mance and functional testing criteria for Nuclear Power Plant closed cooling water systems which are required to perform a specific function in shutting down a reactor or in mitigating the consequences of an accident.

Price: $6.00.

3 "In-Service Monitoring of Core Support Barrel Axial Preload in Pressurized Water Reactors"

This standard addresses the use of excore neutron detectors to detect significant loss of axial preload at the core support barrel upper support flange. The standard also provides criteria for use of an in-service surveillance program.

Price: $4.00.

Copies can be obtained by contacting Kenneth I. Baron, Nuclear Engineering Administrator, ASME, 345 E. 47th St., New York, N.Y. 10017; (212) 644-7802.

Chinese Boiler Experts to Visit U.S.

The China Association for Standardization (CAS) will send four experts to the U.S. in 1981 to study standardization of boiler and pressure vessels. Their three-week visit to the U.S. results from a cooperative agreement signed by CAS and the American National Standards Institute that calls for the continuing exchange of technical experts in various aspects of standardization. Under its terms, all costs of travel within the U.S., subsistence, and medical treatment are to be paid by the U.S. hosts. International travel costs are paid by the Chinese.

The forthcoming visit has aroused considerable interest in the U.S. because previous study tours of Chinese experts, arranged under the agreement, have resulted in recognition and adoption by China of many American National Standards.

Any company or organization willing to act as a host for part of the visit of the Chinese delegation is requested to contact Daniel W. Smith, American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

New Standards Published

The following publications are available from the ASME Order Department, 345 East 47th St., New York, N.Y. 10017.

- ANSI B16.11-1980, Forged Steel Fittings, Socket-Welding and Threaded (M00016). Prices: $4.50; $3.60 to Mems.
- ANSI B16.37-1980, Hydrostatic Testing of Control Valves (J00067). Prices: $4.50; $3.60 to Mems.
- ANSI/ASME PTC 38-1980, Determining the Concentration of Particulate Matter in a Gas Stream (C00049). Prices: $30.00; $24.00 to Mems.

C&S Meetings Calendar

The following meetings are open to the concerned public, as well as to interested members of the engineering community.

- **PRESSURE TECHNOLOGY CODES AND STANDARDS DEPARTMENT**

Committee for Inspection of Pressure Equipment. Feb. 12, 1981, New York, N.Y.
Purpose of Meeting: To review draft of B626.0.
ASME Staff Contact: Manual Gutierrez, (212) 644-7807

Reinforced Thermoset Plastics (RTP) Corrosion-Resistant Equipment Committee. Feb. 16, 1981, Washington, D.C.
Purpose of Meeting: To start reviewing material for the preparation of an ASME Code for RTP vessels below atmospheric pressure.
ASME Staff Contact: Manuel Gutierrez, (212) 644-7807

Solar Energy Standards Committee. February 1981, San Antonio, Tex.; April 1981, Reno, Nev.; Sept. 1981, Albuquerque, N.M.; November 1981, Washington, D.C.
Purpose of Meeting: To prepare new documents under the scope assigned to the Committee. Specific dates were not available at the time of this publication.
ASME Staff Contact: Manuel Gutierrez, (212) 644-7807

Gas Piping Standards Committee. Mar. 24–25, 1981, Atlanta, Ga.; June 3–5, 1981, Philadephia, Pa.; Nov. 3–5, 1981, San Antonio, Tex.
Purpose of Meeting: Maintenance and revision of the Gas Guide with respect to the most recent federal proposals, notices, and rulemaking.
ASME Staff Contact: Tom McMenamin, (212) 644-7809

The following are the various B31 Code Committee meetings scheduled for 1981 for the purpose of maintenance of the Code with regard to revisions, interpretations, and preparation of new Code Sections.

B31 Pressure Piping Main Committee. Feb. 10, 1981, San Francisco, Calif.; June 2, 1981, Myrtle Beach, S.C.; Sept. 29, 1981, Nashville, Tenn.
ASME Staff Contact: Jerry D'Avanzo, (212) 644-7807

B31.1 Power Piping Section Committee. May 12–14, 1981, Clearwater, Fla.; Oct. 6–8, 1981, San Antonio, Tex.
ASME Staff Contact: Jerry D'Avanzo, (212) 644-7807

B31.3 Chemical Plant and Petroleum Refinery Piping Section Committee. Mar. 23–26, 1981, Fort Lauderdale, Fla.; July 20–23, 1981, Reno, Nev.; Nov. 9–12, 1981, New Orleans, La.
ASME Staff Contact: Alan Bagner, (212) 644-7807

B31.4 Liquid Petroleum Transportation Piping Section Committee. Mar. 17–19, 1981, Nashville, Tenn.; Oct. 6–8, 1981, Boston, Mass.
ASME Staff Contact: Russell Poles, (212) 644-7807

B31.5 Refrigeration Piping Section Committee. Mar. 15, 1981, Newark, N.J.
ASME Staff Contact: Jerry D'Avanzo, (212) 644-7807

B31.8 Gas Transmission and Distribution Piping Systems Section Committee. Apr. 14–16, 1981, New Orleans, La.; July 14–16, 1981, Denver, Colo.
ASME Staff Contact: Russell Poles, (212) 644-7807

B31.10 Cryogenic Piping Section Committee. Mar. 11–13, 1981, Key West, Fla.; June 10–12, 1981, Lake Tahoe, Nev.; Oct. 14–16, 1981, Lake Placid, N.Y.
ASME Staff Contact: Alan Bagner, (212) 644-7807

B31.11 Slurry Pipeline Section Committee. May 19–21, 1981, Pittsburgh, Pa.; Nov. 17–19, 1981, Clearwater, Fla.
ASME Staff Contact: Jerry D'Avanzo, (212) 644-7807

B31 Mechanical Design Committee. Feb. 24–25, 1981, Fort Lauderdale, Fla.; Aug. 25–26, 1981, San Francisco, Calif.
ASME Staff Contact: Jerry D'Avanzo, (212) 644-7807

Boiler and Pressure Vessel Code Committee.
Boiler Code Weeks: Mar. 2–6, June 15–19, Aug. 31–Sept. 4, and Oct. 26–30, United Engineering Center, New York, N.Y.; May 4–8, Chicago, Ill.

SC I	Power Boilers, Thurs.
SC II	Material Specifications, Tues.
SC III	Nuclear Power, Thurs.
SC V	Nondestructive Examination, Wed.
SC VIII	Pressure Vessels, Thurs.
SC IX	Welding, Tues.
SC X	FRP Pressure Vessels, Mon.
SCP	Properties of Metals, Tues.

Purpose of Meeting: To consider revisions to safety rules covering design, fabrication,

continued

C&S Meetings Calendar

and inspection during the construction of boilers, pressure vessels, and nuclear power plant components and containments in order to afford protection of life and property and to provide a margin of deterioration in service so as to give a reasonably long, safe period of usefulness.
ASME Staff Contact: Gerry Eisenberg, (212) 644-7817

• SAFETY CODES AND STANDARDS DEPARTMENT

B30 Safety Standards for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings. Feb. 10–11, 1981, Phoenix, Ariz.
Purpose of Meeting: The committee will work on revisions to current safety standards and answer inquiries with regard to these standards.
ASME Staff Contact: William Berger, (212) 644-7804

A17 Elevator Code Committee. Mar. 11–12, 1981, New York, N.Y.; Apr. 29, 1981, New York, N.Y.; June 10–11, 1981, Washington, D.C.
Purpose of Meetings: The foregoing meetings of the A17 Executive Committee have been scheduled to discuss proposed revisions and interpretation of the Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks.
ASME Staff Contact: David A. Wizda, (212) 644-7804

• PERFORMANCE TEST CODES DEPARTMENT

PTC Supervisory Committee. Mar. 25, 1981, New York, N.Y.; June 24, 1981, New York, N.Y.
Purpose of Meetings: Administrative matters pertaining to Performance Test Codes.
ASME Staff Contact: W. O. Hays, (212) 644-7810

PTC 6 on Steam Turbines. Apr. 29–30, 1981, Chicago, Ill.
Purpose of Meeting: Continuation of the development of Performance Test Codes on Steam Turbines.
ASME Staff Contact: W. O. Hays, (212) 644-7810

PTC 19.22 on Digital Systems Techniques. Apr. 7–8, 1981, San Antonio, Tex.
Purpose of Meeting: Review of industry comments on final draft.
ASME Staff Contact: George Osolsobe, (212) 644-2155

• NUCLEAR CODES AND STANDARDS DEPARTMENT

ASME/ACI Joint Committee. June 16–17, 1981, New York, N.Y.; Sept. 24–25, 1981, Quebec, Canada; Jan. 28–29, 1982, Boise, Idaho
Purpose of Meetings: To update Section III, Div. 2 of the Code.
ASME Staff Contact: Jacklin Cevoli, (212) 644-7642

Committee on Cranes for Nuclear Facilities. Mar. 10–12, 1981, Tampa, Fla.; May 5–7, 1981, St. Louis, Mo.; Sept. 22–24, 1981, Boston, Mass.
Purpose of Meetings: To develop ASME Code for construction of electric overhead and gantry multiple girder cranes with top running bridge and trolley used at nuclear facilities.
ASME Staff Contact: Robert E. Glazier, (212) 644-8048

Committee on Nuclear Quality Assurance. May 18–21, 1981, Atlanta, Ga.
Purpose of Meeting: To develop nuclear quality assurance standards, and to coordinate quality assurance codes and standards covering nuclear power plants and fuel cycle facilities.
ASME Staff Contact: Robert E. Glazier, (212) 644-8048

Committee on Nuclear Air and Gas Treatment. Apr. 13–17, 1981, Atlanta, Ga.; July 1981, Chicago, Ill.; October 1981, Boston, Mass.
Purpose of Meetings: The Committee will develop, review, maintain, and coordinate codes and standards for design, fabrication, installation, testing, and inspection of equipment for HVAC and gas processing systems for nuclear power plants.
ASME Staff Contact: John Millman, (212) 644-8049

Subcommittee on In-Service Inspection of Nuclear Power Plant Components. Feb. 8–12, 1981, San Diego, Calif.; May 11–14, 1981, Seattle, Wash.; Sept. 14–17, 1981, Charlotte, N.C.; Nov. 16–19, 1981, Baltimore, Md.
Purpose of Meetings: Updating and review of ASME Boiler & Pressure Vessel Code Section XI.
ASME Staff Contact: Ken Baron, (212) 644-7802

Committee on Operations and Maintenance of Nuclear Power Plant Components. Feb. 5, 1981, New Orleans, La.
Purpose of Meeting: Development of Nuclear Standards concerned with monitoring, testing, and maintaining components in nuclear power plants.
ASME Staff Contact: Ken Baron, (212) 644-7802

• STANDARDIZATION

Measurement of Fluid Flow in Closed Conduits. Mar. 12, 1981, New York, N.Y.
Purpose of Meeting: Committee will receive reports from its Subcommittees and working groups.
ASME Staff Contact: William Daisak, (212) 644-7912

Z94 Industrial Engineering Terminology. Mar. 27, 1981, New York, N.Y.
Purpose of Meeting: Committee will hear reports from its Subcommittees on the progress of various sections of the Z94 Industrial Engineering Terminology draft.
ASME Staff Contact: William Daisak, (212) 644-7912

Steel Stacks. May 21, 1981, New York, N.Y.
Purpose of Meeting: Committee will discuss the Steel Stacks Preliminary Draft and make plans for the future.
ASME Staff Contact: William Daisak, (212) 644-7912

Hoists—Overhead. May 12–13, 1981, Atlanta, Ga.
Purpose of Meeting: The Committee will review and revise the Hoists—Overhead drafts-in-progress.
ASME Staff Contact: William Daisak, (212) 644-7912

B1 Standards Committee, Standardization and Unification of Screw Threads. Apr. 9, 1981, New York, N.Y.
Purpose of Meeting: The meeting will, among other matters, include reports of Subcommittee activities (including progress of active standards projects), review of metrication activities, and discussion of a proposal for reorganization of the B1 activity.
ASME Staff Contact: C. J. Gomez, (212) 644-8034

IEC/TC 4 Hydraulic Turbines. Mar. 16–21, 1981, Zurich, Switzerland
Purpose of Meeting: To consider revision of IEC Publications 41 and 198, discuss need for governor and turbine guide specifications, standardize nomenclature, consider draft on scale effects.
ASME Staff Contact: Richard McGinnis, (212) 644-7803

B40 Specifications for Pressure and Vacuum Gages. Apr. 30, 1981, San Francisco, Calif.; Oct. 29, 1981, New Orleans, La.
Purpose of Meetings: To discuss revision to analog and digital gage standards, and to determine government needs in this area.
ASME Staff Contact: Richard McGinnis, (212) 644-7803

B18 Standardization of Bolts, Nuts, Rivets, Screws, Washers, and Similar Fasteners. May 21, 1981, Romulus, Mich.
Purpose of Meeting: Discuss various metric fasteners, receive report of ISO/TC 2 on fasteners, as well as consider government needs in this area.
ASME Staff Contact: Richard McGinnis, (212) 644-7803

(Continued from page 14)

O-Rings

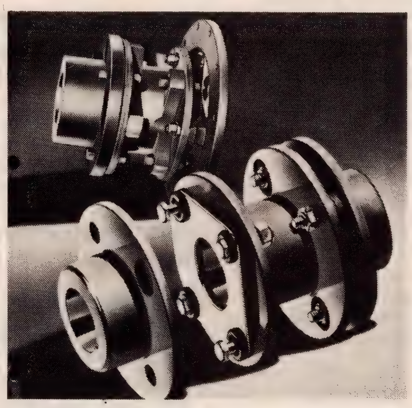
Greene, Tweed & Co.—Newly revised bulletin describes its low friction, wear-resistant GO-Ring, designed for long-life dynamic applications in non-lubricated and lubricated systems. The low breakout and running friction of the GO-Ring minimizes "stick slip" which is inimical to the performance of equipment requiring precise control of motion or where response characteristics, even to small pressure variations, are small.

Circle 176 on Reader Service Card

Electrical Position Sensor

Columbia Research Laboratories, Inc.—Announce new line of electronic position sensors of the DDCP Series operate from a d-c power source and provide a d-c output precisely-proportional to the displacement of the core and can react in milliseconds. Instantaneously, the electrical signal can be filtered, rectified, compared, regulated, selected, rejected or a computer operation performed before the final controlling action is completed. Applications include gaging and inspection, servo feedback and machine control in aerospace and industry, where fast, accurate displacement measurements performed by unskilled personnel may be required.

Circle 177 on Reader Service Card



Flexible Couplings

Formsprag Div., Dana Corp.—New 32-page Catalog 3045-A describes its line of single- and double-flexing couplings. They feature all-metal construction, are non-lubricated and consist of two hubs, a spacer, and one or two sets of laminated flexible elements. Advantages include no moving parts to wear out, torsional rigidity, minimal backlash, and long life with high misalignment capability. The couplings come in a wide range of models and sizes.

Circle 178 on Reader Service Card

Product Catalog

The Crosby Group—New 64-page engineering journal contains many application guides and load rating tables for a wide range of blocks, chain, hooks, rings, turnbuckles, shackles and other products used in lifting and pulling.

Circle 179 on Reader Service Card

Butterfly Valves

ITT Grinnell Valve Co., Inc.—The Dyna-Lok® High Performance Butterfly Valve is designed to extend the range of conventional butterfly valves with shutoff capabilities of steel gate and ball valves. Its use is intended to cover a broad range of industrial applications including chemical, petrochemical power, paper, cryogenic and marine. The valve's design allows the user the option of many service applications with no seal or configuration modifications.

Circle 180 on Reader Service Card

Whiteprinter

Diazit Co., Inc.—A low priced, full sized, fully sychronized, low volume diazo copier, the Diazit® DART 100. A touch of a button allows instant on/off operation to produce clear bluelines, blacklines, sepias, polyester film intermediates, and other diazo copies at speeds up to 14 fpm. Features include: electronic speed control, full 42 in. printing width, Pyrex® glass printer cylinder, dry ammonia vapor development and an automatic built-in ammonia pump.

Circle 181 on Reader Service Card

Autoclave System

CorTest, Inc.—A compact (19 × 18 × 30 in.) autoclave system includes everything required for testing metals and polymers at pressures up to 5000 psi at 500°F. Easy-to-read pressure and temperature gauges, an elapsed time indicator, and all operating controls are grouped on the conveniently tilted control panel for maximum operating efficiency. The two-coil heater, timer, and over-all power to the unit are independently operated by separate on/off switches. Desired temperature is established, and automatically maintained within accurate limits, by means of a proportional temperature control.

Circle 182 on Reader Service Card

Hydraulic Torque Converters

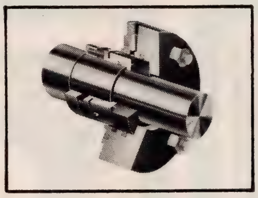
National Supply Co.—Its Model C torque converters for oilfield and industrial applications are described in a new six-page brochure. The torque converters are designed for large prime movers of up to 2000 hp, and for tasks involving high load shocks. Typical applications include drawworks and pump drives in the oilfield and cranes, aggregate crushers, power shovels and metal shredders among industrial applications.

Circle 183 on Reader Service Card

Microprocessor In-Line Blender

Waugh Controls Corp.—The new Model 2200 Microblender, for control of multiple streams, solid or liquid, in the petroleum, chemicals, cement, food and other industries, features simple operating procedures, with English language prompting for all data entry, two-way communication with a remote supervisory computer, magnetic card reader for storage and instant entry of an unlimited number of blend recipes, plus built-in logic and interfacing relays for pump start and valve line-up.

Circle 184 on Reader Service Card



keep informed

Flow Pumps

Patterson Pump Co.—Catalog AMF-75 covers its line of Axial and Mixed Flow Pumps designed to move large volumes of liquids at low to medium heads with efficiency and economy. Fabricated parts are machined as a unit for true alignments and vibration free operation is possible due to spacing of line shaft bearings and grease-packed suction ball bearing. Features include: Capacities from 2000 to over 100,000 gpm; heads from 5 ft to 75 ft in single stage units; sizes from 8 in. to 48 in.; horizontal or vertical positioning; material selection to meet almost any pumping requirement; bronze or rubber sleeve-type bearings; and packed stuffing box or mechanical seals to assure no leakage at the surface.

Circle 185 on Reader Service Card

Double Valves

Ross Operating Valve Co.—New 12-page Bulletin 344A, "Double Valves," features photographs, cutaways, dimensions and model numbers on five different models. The Ross Parallel Flow Double Valves are available with either the Lifeguard® pneumatic monitor or the E-P combination pneumatic and electric monitor. Both are designed to monitor asynchronism of the valve elements and inhibit further valve operation until the monitor is reset.

Circle 186 on Reader Service Card

Metering Steam

The Singer Co., American Meter Div.—Six-page bulletin covers the metering of steam for energy conservation and details the company's line of recording or indicating orifice meters. They can include integrators to totalize steam flow, with digital read-out at the instrument or, optionally, also at a remote location. The bulletin also describes the operating principles for steam orifice meter measurement in terms of pounds per hour.

Circle 187 on Reader Service Card

Back-Up Rings

Tetrafluor, Inc.—A new 22-page catalog describes over 1300 standard sizes of back-up rings. Designed to prevent extrusion in rubber O-ring sealing systems, Teflon® back-up rings are available in single turn (scarf cut), multi-turn (spiral cut) and solid (uncut) configurations. In addition to the military standards, Tetrafluor supplies three series of extended dash sizes to cover the entire range of the AS-568A Uniform Numbering System.

Circle 188 on Reader Service Card

Poppet Valve

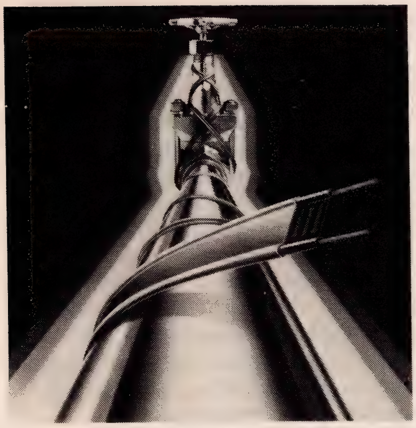
Schrader Bellows—Rhino King® is a new 4-way poppet valve recommended for non-lubricated service. The valve is designed for high production applications in hostile environments such as foundries, steel mills and automotive manufacturing plants.

Circle 189 on Reader Service Card

Mechanical Agitator Shaft Seals

Nooter Corp.—Technical Bulletin 104 covers Nooterseal® mechanical agitator shaft seals and design pressures, temperatures, and shaft diameters as well as required apurtenances. In addition, a detailed description and cutaway sketch of a typical bottom entry shaft seal is presented.

Circle 190 on Reader Service Card



Cable Heats Instrument Lines

Nelson Electric—Limitrace is a self regulating electric heating cable applicable on instrument lines. It doesn't require a thermostat and it automatically regulates heating output even on $1/4$ and $3/8$ in. tubing lines normally used for instruments. Limitrace is applied on close-coupled flow and pressure instruments that may have impulse lines that are 2 to 3 ft long while analyzers may have lines 100 to 150 ft. This cable can be cut to any length and still provide necessary wattage output.

Circle 171 on Reader Service Card

Hydraulic Motors

Planet Products Corp.—Smooth operation at very low speeds is a feature of its hydraulic motors which makes them particularly well suited for "pulse-free" operations such as robots and other programmable manipulators. The motor's low rpm capabilities and very small start-run pressure are significant in robotic application. The variable displacement Model MV .93 has 20 ball pistons uniformly distributed and ported. They react with precision anti-friction bearing displacement rings to give the virtually pulseless, vibration-free output rotation at almost any speed.

Circle 172 on Reader Service Card

Complete Control Capabilities for Coal-Fired Boilers

Bailey Controls Co.—New brochure, "Control Systems For Coal-Fired Boilers," features three Bailey systems for coal-fired boiler control. Whether plans include implementation of current boiler technology or retrofitting an existing boiler with coal-firing capabilities, Bailey control systems provide reliable operation for coal-fired industrial and utility boilers. Both burner and combustion controls are available for pulverized coal or stoker-firing methods.

Circle 173 on Reader Service Card

keep informed

Silencer Selection Guide

Quietflo, Div. Flaregas Corp.—A revised and expanded bulletin for sizing and selecting in-line silencers for pressure reduction systems is now available. The Quietflo LAS silencer is designed to provide maximum attenuation in the high frequency range by absorption, thereby reducing excessive noise to acceptable limits. Engineers can use the sizing chart contained in the bulletin to select standard silencers for gas flow rates up to 32,000 ACFM, and noise reductions of 20 to 45 dB. Larger sizes, or greater attenuation, can be custom designed to suit individual applications.

Circle 191 on Reader Service Card

Transducers

Comptrol Inc.—New 36-page Technical Manual, B-31 describes its complete line of Superloadcells and controls. As precision linear force transducers, the Superloadcells are especially designed for the measurement and control of web or strand tension on continuous processing lines. A pair of Superloadcells mounted under the pillow-block bearings of an idler roll will convert the force of tension into an electrical signal which is directly proportional to the tension load. Available in 25 tension ranges, the Superloadcells may be mounted in any position and will operate at any wrap angle.

Circle 192 on Reader Service Card

Hydraulic Power Units

Hydro Systems, Inc.—A new Hydro Pak hydraulic power unit catalog simplifies the ordering process through the use of numerical codes. The specifier can originate the model number for a power unit without having to clarify all specifications in written form. The catalog also gives data to help determine realistic heat removal requirements for successful application.

Circle 193 on Reader Service Card

Stem Actuater Valve

Beswick Engineering Co.—The Beswick miniature stem actuated valve features an end which includes the inlet port swivels to provide the flexibility of a universal ell within a $1\frac{1}{2}$ in. overall length. The valve comes in normally open and normally closed two- and three-way versions with 10–32 outlet ports and 10–32 or $\frac{1}{8}$ NPT inlet ports. The nose thread is 15/32-32 and the valve is provided with lock washers and a nut. Pushbutton, air pilot and ball actuators are available.

Circle 194 on Reader Service Card

Computer System for Plants

Litton Industries—The "DCS 5000" (Distributed Control System) is a new, easy-to-use microprocessor-based energy and facility management computer system for industrial plants or commercial buildings. Knowledge of computers is not required to operate the system. Its size can be expanded to parallel the growth of a company's production. The operator of the DCS 5000 can decide what equipment in the plant should be attached to the system, then communicate to the system that a new piece of equipment has been connected (or a whole new building or production line) to be monitored or controlled.

Circle 195 on Reader Service Card

keep informed

Hi-Tech Table

Plan Hold Corp.—Called a "cordless automatic," its new, patented Hi-Tech drawing table features a set of leaf springs that eliminates maintenance while providing feather touch adjustment of the height, angle and position of the drawing surface. The top glides to a comfortable sitting or standing height with the touch of a toe. The tilt of the top, from flat to vertical, is changed as easily as shifting a car from park to drive. And, the top can be rotated 180 deg to catch the best natural light or provide a better drawing position.

Circle 168 on Reader Service Card

Waste Disposal System

Industronics, Inc.—The Conserth-erm waste disposal system allows hazardous/toxic waste producers to maintain in-house control while realizing energy recovery. The system will thermally destroy, on a continuous 24 hr a day basis, a wide variety of industrial and municipal wastes. The high efficiency energy and material recovery features incorporated in the design lead to a very rapid return on investment. Its modular design adds versatility in meeting Federal and State EPA standards. Waste material is introduced into the rotating, primary oxidation chamber where the incineration process reduces the waste to an ash. The sterile ash, along with the noncombustible material (metal, glass, etc.), is then deposited in a recovery system.

Circle 169 on Reader Service Card

Pumps for Hydrocarbon Processing

Worthington Group, McGraw-Edison Co.—Eight-page brochure describes and illustrates a broad range of API 610 pumps and miscellaneous offsite pumps available from Worthington for hydrocarbon processing. Photos, cutaway drawings and operating data accompany descriptions of 11 types of API 610 pumps. Miscellaneous (offsite pumps) shown and described include two horizontal centrifugal pumps; a vertical in-line centrifugal unit; a Sier-Bath horizontal positive displacement two screw design; and a deepwell or short-coupled vertical turbine pump.

Circle 170 on Reader Service Card

Tube Fittings

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Circle 174 on Reader Service Card

Computer Systems Services

Wyle Laboratories—New brochure describes its computer systems services to industry and government. In addition, it describes a few typical application examples such as in energy systems, manufacturing and processing operations, transportation, structural analysis, and acoustics.

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Opportunities

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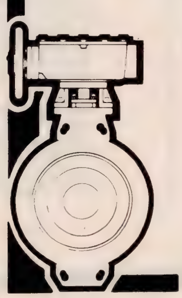

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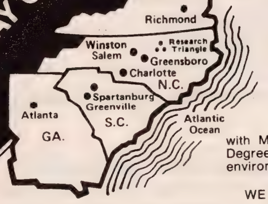

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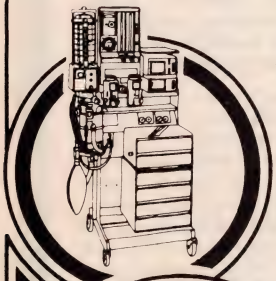

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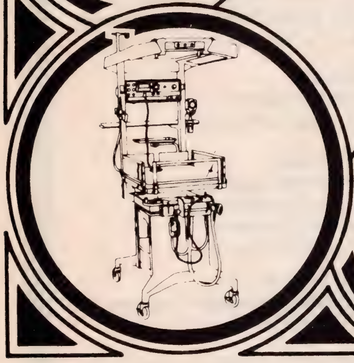

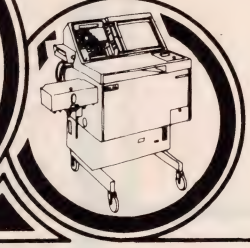

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positions open

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IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, (UNIVERSITY OF LONDON), MECHANICAL ENGINEERING DEPARTMENT. The department wishes to appoint lecturers able and willing to teach at undergraduate level in a range of mechanical engineering subjects, and having research interests in any aspect of Mechanical Engineering (including nuclear power and control engineering). The department wishes to appoint also two lecturers with special interests in manufacturing technology, to work with a newly-appointed professor of engineering manufacture in an enlarged manufacturing technology section. Salary will be on the lecturer scale, £5505 to £11,575 plus £967 London allowance. Further particulars may be obtained from Professor S. A. V. Swanson, Mechanical Engineering Department, Imperial College, London, SW7 2AZ to whom application should be sent to arrive by 31st January 1981.

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The UNIVERSITY OF JORDAN, FACULTY OF ENGINEERING AND TECHNOLOGY. Applications are invited for academic posts in Mechanical Engineering specialized in Machine Design, Production, Refrigeration and Air conditioning, Vibration, and combustion Engines. Qualifications: BSc. and Ph.D. in Mechanical Engineering plus relevant experience. The Salary depends upon qualifications and academic experience and would be within the ranges, JD 450 to JD 550 for Assistant Professor J.D. 550–650 for Associate Professor and J.D. 700–830 per month for full Professor for those who are eligible to hold an academic title, plus travel costs (1 US dollar = 0.30 JD approx., 1 pound Sterling = 0.73 JD approx). Applicants should submit a detailed C.V. with the names of three referees before 1 Feb. 1981 to: Appointments Committee, University of Jordan, Amman—Jordan.

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THE DEPARTMENT OF AEROSPACE ENGINEERING AND APPLIED MECHANICS at the University of Cincinnati has a tenure-track Assistant or Associate Professional position for an outstanding candidate with a background in the propulsion/combustion and experimental propulsion/fluid dynamics areas. The candidate should have a Ph.D. and have demonstrated ability or potential to fulfill the requirements of excellence and leadership in both teaching and research in the requisite topic area. In addition to classroom involvement, initiation of independent or collaborative research studies is required. Inquiries should be made to: Professor S. G. Rubin, Department of Aerospace Engineering and Applied Mechanics, 798 Rhodes Hall, UNIVERSITY OF CINCINNATI, Cincinnati, Ohio 45221. The University of Cincinnati is an Equal Opportunity/Affirmative Action Institution.

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positions open

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ASSISTANT DEAN—SCHOOL OF ENGINEERING, WESTERN NEW ENGLAND COLLEGE. Applications and nominations are invited for the position of Assistant Dean of the School of Engineering. The Assistant Dean of Engineering reports directly to the Dean and has general responsibility for the support services within the school. The position is available September 1, 1981. Qualifications include an earned doctorate in Engineering (Electrical, Industrial, Mechanical) and academic experience suitable for appointment to a senior rank in a department. Strong communication skills, a facility in interpersonal relationships, and administrative experience are desirable attributes. Salary and rank will be commensurate with experience. The School has a distinguished history in undergraduate education and has expanding activities in graduate education and research. Currently the school serves 430 full-time and 200 part-time undergraduates, and 50 graduate students. Letters of nomination, resumes, names, addresses, and telephone numbers of three references are to be received before March 15, 1981 to: Dr. R. Luther Reisbig, Dean, Western New England College, 1215 Wilbraham Road, Springfield, MA 01119. An equal opportunity, affirmative action employer.

MECHANICAL ENGINEERING FACULTY POSITIONS. THE UNIVERSITY OF MASSACHUSETTS AT AMHERST anticipates having two tenure track faculty positions at the Assistant/Associate Professor level for the machine design area with specialty in component design, stress analysis, failure prevention analysis, reliability or computer-aided-design with strong interest in applications. Ph.D. in Mechanical Engineering, or a closely related field, is required. Position requires undergraduate and graduate teaching activity with research responsibilities. Experience with sponsored research programs, particularly on programs dealing with manufacturing research, is desirable. Send detailed resume and the names of three references to Corrado Poli, Professor and Head, Department of Mechanical Engineering, University of Massachusetts, Amherst, MA 01003. The University of Massachusetts is an equal opportunity/affirmative action employer.

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FACULTY POSITION—MECHANICAL ENGINEERING, September 1980. Applicants should have a doctoral degree in Engineering with a strong background in either thermodynamics, heat transfer and fluid mechanics or kinematics, dynamics and machine design. Duties will include teaching undergraduate and graduate courses, research activity in specialty area, cooperative research with Engineering faculty colleagues, and development of related instructional and research laboratories. Potential research ability and demonstrated research interest are essential for obtaining an academic appointment. Industrial experience, teaching experience, evidence of inventiveness and other related accomplishments will be given special consideration. Please send resumes and references to: Prof. James J. Wert, Chairman, Dept. of Mechanical Engineering and Materials Science, VANDERBILT UNIVERSITY, Box 1621, Station B, Nashville, TN 37235. Vanderbilt University is an equal opportunity and affirmative action employer.

THE DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING AT THE UNIVERSITY OF VIRGINIA is seeking applications for faculty positions at the Assistant and Associate Professor levels beginning in September 1981. Consideration will be given to persons with an earned doctorate capable of high quality performance in research and teaching. Applications are invited from all areas of Mechanical and Aerospace Engineering from persons who will be expected to teach at both the undergraduate and graduate levels and to develop and generate funding for research programs in his or her area of expertise which will be suitable for training students at the masters and doctoral levels. Interested applicants should send a resume and references to Professor John E. Scott, Jr., Chairman, Department of Mechanical and Aerospace Engineering, University of Virginia, Charlottesville, Virginia 22901. The University of Virginia is an affirmative action/equal opportunity employer and encourages applications from persons of minority races and women.

MECHANICAL ENGINEERING FACULTY POSITIONS—Two full-time tenure-track positions available beginning Fall 1981: One in the area of metallurgical engineering and the other in the area of applied fluid mechanics. Must have a Ph.D. or equivalent (equivalency requires M.S., P.E. registration and a minimum of five years industrial experience). Desirable qualities include an active interest in teaching undergraduate and graduate courses, directing and developing related laboratories, sponsor student design projects, and some industrial background. Rank and salary will be commensurate with qualifications and experience. Application deadline is March 1, 1981. Send resume and three references to: Dr. Ram Manvi, Chairman, Department of Mechanical Engineering, CALIFORNIA STATE UNIVERSITY, LOS ANGELES, 5151 State University Drive, Los Angeles, California 90032. An Equal Opportunity/Affirmative Action/Handicapped/Title IX Employer.

MECHANICAL AND AEROSPACE ENGINEERING: OKLAHOMA STATE UNIVERSITY. Faculty positions at the assistant or associate professor level available for January or August 1981. Applicants should have teaching and research interests in one or more of the following areas: mechanical design, manufacturing, structures, dynamics and control, fluid mechanics and aerodynamics, thermal sciences, energy conversion and propulsion, and environmental systems. Earned doctorate or equivalent in experience required. Industrial experience is desirable but not required. Send resume and list of references to Dr. Karl N. Reid, Professor and Head, School of Mechanical and Aerospace Engineering, OKLAHOMA STATE UNIVERSITY, Stillwater, Oklahoma 74078. An equal opportunity/affirmative action employer.

PROJECTED OPENINGS in Mechanical Engineering starting fall 1981. Postions will be at assistant or associate professor level. Candidates should have a PhD in Mechanical Engineering and established competence in one of the following areas: controls, manufacturing processes, thermal science, industrial engineering, or computer aided design. Expected to teach undergraduate and graduate courses and develop scholarly activities in research and publication. To apply, submit letter of interest, complete resume, and names and addresses of three professional references to: Dr. C. W. Chiang, Department of Mechanical Engineering, SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLGOY. Rapid City, SD 57701. An affirmative action/equal opportunity employer.

TEACHING OVERSEAS: MECHANICAL ENGINEERING DEPARTMENT, AMERICAN UNIVERSITY OF BEIRUT, Lebanon. Teaching positions starting October 1981 in the fields of: (1) Materials Processing (Mechanical or Industrial Engineer), (2) Applied Mechanics and/or Design, (3) Energy Technology. To teach courses and conduct research in the field and teach courses in allied fields. Preference is for candidates with industrial or teaching experience. Salary and rank commensurate with qualifications. Generous fringe benefits. Mail resume to American University of Beirut Personnel Services, 380 Madison Avenue, New York, NY 10017. Also air mail copy to Dean of Engineering & Architecture, American University of Beirut, Beirut, Lebanon. An equal opportunity/affirmative action employer.

positions open

UNDERGROUND FRACTURING PROJECTS; RESEARCH POSITIONS AVAILABLE: A number of positions are now available, to be filled during calendar year 1981, in connection with government and industry-sponsored research on underground fracturing techniques for extraction of resources such as oil, gas and minerals. Both analytical and experimental approaches are being developed, toward understanding the evolution of mechanically, thermally or chemically induced cracking, with the immediate objective of improving designs for gaining access to underground reservoirs (e.g. by explosives and hydraulic fracturing). Determination of relevant material properties, and their incorporation into realistic theoretical and laboratory simulations, will be required to model the coupled structural deformation and fluid flow in fractures and pores. There is a particular need for individuals with extensive laboratory experience in relevant fields, such as materials testing and design of mechanical systems. Practical skills in instrumentation, the use of modern data acquisition/processing equipment and in servo-control methods, would be a great asset. Skilled analysts are also being sought for the theoretical modelling. Appointments will probably be made at the postdoctoral or research associate levels, but they will be commensurate with experience; resourceful persons who can take charge of expanding capabilities, perhaps with experience in the project area, will be especially suitable. Opportunities to teach will exist, if desired. Candidates should have a good background and a suitable degree in appropriate disciplines of engineering, applied physics or mathematics. A number of research assistants will also be required, for both analytical and experimental work. These projects will be part of a developing Resource Extraction Laboratory and will be connected with the M.I.T. Minerals Institute. It should be noted that M.I.T. has a new research appointments structure, whereby excellent opportunities now exist in non-teaching research positions. Interested parties should contact and send resumes to: Prof. Michael P. Cleary, c/o MIT Personnel Office, E19-239, 77 Massachusetts Avenue, Cambridge, MA 02139. (Please refer to Job No. R80-39.) MIT is an equal opportunity/affirmative action employer.

MECHANICAL ENGINEERING—ASSISTANT PROFESSOR—To be involved in graduate and undergraduate instruction, curricular and laboratory development, and in research in any of the traditional branches of Mechanical Engineering. Applicants will be expected to develop an individual area of research competency eventually leading to external funding. Doctorate and educational background in Mechanical Engineering are required. Preference will be given to applicants possessing industrial and/or laboratory experience. Professional registration or EIT status highly desirable. Position available in Fall (1981). Applicants must be postmarked before February 28, 1981. Immigration status of foreign nationsl should be stated in resume. Address inquiries and applications to: Dr. T. E. Mullin, Chairman, Search Committee, Department of Mechanical Engineering, UNIVERSITY OF LOUISVILLE, Louisville, Kentucky 40292. An Equal Opportunity/Affirmative Action Employer.

MECHANICAL ENGINEERING faculty position open for fall 1981. Full-time tenure track position at assistant/associate professor level. Duties include undergraduate and some graduate teaching, and directing related laboratories. Desired area of expertise is: ME design, kinematics, machine elements, machine design, stress analysis, computer aided design, mechanical vibrations; OR, SOLID MECHANICS—solid mechanics, fracture mechanics, experimental stress analysis, finite element analysis. Ph.D. and professional registration preferred; teaching and/or industrial experience desirable. Applicants should have undergraduate degree in Mechanical Engineering. Send resume to: Dr. Halit M. Kosar, Dean, College of Engineering, GANNON UNIVERSITY, Erie, Pennsylvania 16541. Gannon University is an Equal Opportunity/Affirmative Action Employer.

THE MECHANICAL ENGINEERING DEPARTMENT AT THE UNIVERSITY OF WISCONSIN-PLATTEVILLE invites applicants for tenure track positions at the assistant or associate professor level starting in the fall of 1981 in the area of mechanical design. A background or interest in manufacturing, controls, and/or materials is desirable. Duties of the position include teaching a wide spectrum of courses and the development of courses and laboratories in a relative new, practically oriented undergraduate program. Prefer Ph.D with industrial experience and a strong interest in teaching rather than research. Send resume to: Ross A. Fiedler, Chairman; Department of Mechanical Engineering; University of Wisconsin-Platteville; Platteville, Wisconsin 53818. An Equal opportunity/affirmative action employer.

The University of Utah, Department of Civil Engineering, expects faculty openings in one or more of the following areas: (1) Mechanics of solids and structures, with interest in earthquake engineering, (2) experimental fluid mechanics with interest in environmental engineering, (3) mechanical behavior of composite materials, (4) transportation engineering. Candidates should have a Ph.D. degree and a strong interest in sponsored research. All positions are tenure-track. Rank and salary open. Apply to: Dr. George J. Dvorak, Chairman, Civil Engineering Department, UNIVERSITY OF UTAH, Salt Lake City, UT 84112. Affirmative Action/Equal Opportunity Employment. Deadline for applications is 1 April 1981.

THE MECHANICAL ENGINEERING DEPARTMENT OF NORTHEASTERN UNIVERSITY invites applications for full time tenure—track faculty positions in the areas of Mechanics, Design and Thermal Science to begin April 1, 1981 or later. In addition to teaching responsibility at the undergraduate and graduate levels, the applicant must be prepared to initiate and sustain a strong research program. Rank and salary will be commensurate with qualifications and experience. Applicants should send complete resume and names and addresses of three references to Professor Welville B. Nowak, Department of Mechanical Engineering, Northeastern University, Boston, Massachusetts 02115. An Equal Opportunity employer.

positions open

BUCKNELL UNIVERSITY, Department of Mechanical Engineering has an opening for a tenure track position at the assistant professor level available September 1981. To qualify for consideration, a candidate must have an undergraduate degree in mechanical engineering, and should have a Ph.D. degree or should be committed to earning a Ph.D. degree in a field appropriate to the teaching responsibilities. The successful candidate must be dedicated to the teacher/scholar concept and must be willing to teach courses and develop and manage laboratories in the field of mechanics at the Bachelor's and Master's Degree level. Bucknell is a private, coeducational university of 3200 students with a strong 650 student Engineering College that offers the Bachelor's and Master's Degrees. The University is located on a 300 acre campus overlooking the Susquehanna River Valley in the hills of Central Pennsylvania. Applications including three references should be sent prior to February 15, 1981 to Charles H. Coder, Head, Department of Mechanical Engineering, Bucknell University, Lewisburg, Pennsylvania 17837. Applications from women and minorities are encouraged.

MECHANICAL ENGINEERING: Automatic Control Specialist, tenure-track, position available fall semester 1981. Rank and salary commensurate with qualifications. Experience in industry and/or university preferred; Ph.D. required. Candidates must be qualified to teach undergraduate and graduate courses and participate in an expanding controls research program. Secondary interest in machine design, vibrations, graphics, process control or HVAC desirable. Preference given to articulate candidates with an innate curiosity, a desire to teach, and the ability to work well with students and colleagues. Send resume to Dr. Paul L. Miller, Professor and Head, Mechanical Engineering Department, KANSAS STATE UNIVERSITY, Manhattan, Kansas 66506. Telephone inquiries invited (913 532-5610). Applications will be accepted through February 16, 1981. Kansas State University is an Equal Opportunity/Affirmative Action Employer.

MECHANICAL ENGINEERING DEPARTMENT, UNIVERSITY OF EVANSVILLE, invites resumes for tenure-track 1981–82 faculty appointments. Prefer background in mechanical systems or thermal sciences. Require demonstrated teaching ability and M.S. with industrial experience or Ph.D. Rank and salary dependent on qualifications. Number of positions will be determined by March 1, 1981. Programs emphasize undergraduate teaching and industrially co-sponsored senior projects. Private university offers small classes, competitive compensation, urban consulting opportunities and small city life-style. Send resume to: Chairman, ME Search Committee, Mechanical Engineering Department; University of Evansville; P.O. Box 329; Evansville, Indiana 47702. An equal opportunity/affirmative action employer.

THE MECHANICAL ENGINEERING DEPARTMENT AT TEXAS A&M UNIVERSITY has several tenure-track faculty positions open in the areas of thermal-fluid science, materials, controls, HVAC systems, computer-aided design, manufacturing, and mechanical systems. Applications are invited for these positions. Applicants should have a specific interest in teaching and developing research in a relevant area. Rank will depend on the qualifications and experience of the applicant. Interested persons should forward resumes to Professor Gordon R. Hopkins, Head, Mechanical Engineering Department, Texas A&M University, College Station, Texas 77843. Texas A&M University is an affirmative action, equal opportunity employer.

GRADUATE RESEARCH ASSISTANTSHIPS IN WATER RESOURCES AND HYDRAULICS—ST. ANTHONY FALLS HYDRAULIC LABORATORY, Department of Civil and Mineral Engineering, UNIVERSITY OF MINNESOTA, invites applications for graduate study and research in water resources engineering and fluid mechanics leading to M.S.C.E. and Ph.D. degrees. Stipend for academic year approximately $5800 plus resident tuition rates. Summer work usually available. Attractive fellowships for supplemental support also available through the Department. For details and application forms write to Director, St. Anthony Falls Hydraulic Laboratory, Mississippi River at 3rd Avenue S.E., Min-

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OAKLAND UNIVERSITY, ROCHESTER, MICHIGAN. The School of Engineering invites applications for a position in Mechanical Engineering with expertise in Finite Elements, Machine Design and Dynamics or in Energy Conversion, Combustion and Thermodynamics. Starting date August 15, 1981. Duties include undergraduate and graduate teaching and research. Interest in sponsored research essential. Doctorate required. Position is tenure track with salary and rank dependent upon qualifications. Oakland University is a Ph.D. granting, state supported University and is an Equal Opportunity/Affirmative Action employer. Send resume to Dean of Engineering, Oakland University, Rochester, Michigan 48063.

MECHANICAL ENGINEERING-ENGINEERING MECHANICS DEPARTMENT AT MICHIGAN TECHNOLOGICAL UNIVERSITY invites applications for two tenure track positions. Rank and salary open. (i) Energy-Ph.D. with interest in energy conservation/conversion. Power plant design experience desirable. (ii) Fluid Mechanics: Ph.D. with interest in experimental and/or computational fluid mechanics with emphasis on turbulence. Applicants should have interest in undergraduate and graduate teaching, and research. They should also have an interest in pursuing external support for research. Degrees offered are B.S., M.S. and Ph.D. The Department has a faculty of 45 and a current enrollment of 1400 undergraduate and 50 graduate students. Send resume with the names of three referees to Dr. N. V. Suryanarayana, Chairman, Search Committee (Energy and Thermo-fluids Area), ME-EM Department, Michigan Technological University, Houghton, MI 49931. Applications must be received by February 15, 1981. Michigan Technological University is an equal opportunity educational institution/equal opportunity employer.

positions open

FACULTY POSITION—Materials Processing and Machine Design. The Department of Mechanical and Aerospace Engineering at North Carolina State University is seeking a qualified individual in the areas of Materials Processing and Machine Design at the Rank of Assistant Professor. Higher ranks may be considered. Responsibilities of the position include teaching and research. Teaching duties will be at both the undergraduate and graduate level in Mechanical Engineering. The candidate must have an interest in both materials processing and machine design and the interrelationship between the two areas. In addition, the candidate must be able to attract and participate in sponsored research. Previous teaching and industrial experience is desirable. The candidate must have a Ph.D. in Mechanical Engineering or other closely related field. The Mechanical and Aerospace Engineering Department has a faculty of 30, an enrollment of approximately 1,000 undergraduate and 100 graduate students. The Department is heavily involved in research. The University is located in the Triangle Park area that contains the North Carolina Research Triangle Park, Duke University, and the University of North Carolina at Chapel Hill. Appointment will be effective July 1, 1980. Applicants for this position should submit a letter of interest and resume to: Dr. John A. Bailey, Chairman, Search Committee (MP/MD), Department of Mechanical and Aerospace Engineering, NORTH CAROLINA STATE UNIVERSITY, Raleigh, North Carolina 27650. (919) 737-2876 or (919) 737-2279. The University is an Equal Opportunity Employer and operates under Affirmative Action Policy.

MECHANICAL ENGINEER. As you perform major responsibilities in a professional manner, so has our agency established a high professional and confident standard with our corporate clients and engineering applicants over the last 17 years. We represent many leading corporations in all major industries throughout the United States. Present opportunities include Project Management, Plant Engineers, Entry Level Positions, Senior Processing Engineers, Development Engineers and Mechanical Engineers. Salaries $15–35,000. An engineering representative of our firm will contact each applicant concerning career objectives, current openings, and discuss the present employment market and its effect on your requirements. Please send resume in confidence to: KENNETH B. ANDERSON PERSONNEL, Box 144, 229 Lancaster Ave., Devon, PA 19333 (215) 687-1215. Nationally Affiliated.

DEPARTMENT HEAD, INDUSTRIAL AND MANAGEMENT SYSTEMS ENGINEERING. Position open July 1981. Department has programs in manufacturing, management systems, and human factors. Desired qualifications include an earned doctorate, research experience and accomplishments, teaching experience at both the graduate and undergraduate level, administrative skills, and activity in professional societies. Rank of appointment will be Full Professor on a full year basis. Applications should include resume, list of publications, and names of three references. Application Deadline: March 1, 1981. Send to: Chairman, Search Committee, Department of Industrial and Management Systems Engineering, The Pennsylvania State University, Code Number A, 207 Hammond Building, University Park, PA 16802. An Affirmative Action/Equal Opportunity Employer.

THE DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING AT THE UNIVERSITY OF MISSOURI-COLUMBIA is inviting applications for a tenure-track position in the teaching/research area of computer-aided design. Ph.D. in mechanical engineering or related area needed industrial experience desired. Rank and salary commensurate with experience. Write Chairman, Department of Mechanical and Aerospace Engineering, UNIVERSITY OF MISSOURI-COLUMBIA, Columbia, Missouri 65211 prior to February 15, 1981. Equal opportunity/affirmative action employer.

FACULTY POSITION, MECHANICAL ENGINEERING TECHNOLOGY. THE PENNSYLVANIA STATE UNIVERSITY, Hazleton Campus invites applications for a position beginning Fall 1981 Term. Candidates must have earned Master's or Doctorate in Engineering, pertinent academic, industrial or professional experience of not less than 6 years, professional registration and evidence of continued professional development. Send letters of interest and resume to Associate Director of Academic Affairs, Hazleton Campus, The Pennsylvania State University, Hazleton, PA 18201. An equal opportunity, affirmative action employer.

ENGINEERING RESEARCH ASSOCIATE. Responsible for conducting sponsored research tasks in the solar photovoltaic energy areas. Specific activities include test planning, laboratory operations, post-testing evaluations, etc. Minimum qualifications: B.S. in electrical, mechanical, or related engineering with two years of industrial or research experience. M.S. preferred. Starting date April 2, 1981. $24,000–27,000. Send application letter with resume including three references by January 31, 1981 to: Dr. G. C. Chang, Associate Dean of Engineering, CLEVELAND STATE UNIVERSITY, 1983 E. 24th St., Cleveland, Ohio 44115. Equal Opportunity Employer M/F/H.

SR. RESEARCH ENGINEER to contribute to creative development of automation/control systems; require MS or PhD–M.E. plus postgraduate experience, institutional or industrial, translating theoretical concepts into sophisticated systems for increased productivity in consumer and industrial goods manufacture. Excellent career opportunity with recognized industrial leader headquartered mid-Atlantic but with several divisions in the southeast. Salary to 40K. KENNETH B. ANDERSON, INC., Box 158, 229 W. Lancaster, Devon PA 19333, 215-687-1215.

NO SUN SHORTAGE—The Southeast has lots of sunshine and our client companies have immediate needs for all engineering disciplines. Why wait? Completely confidential. All fees paid. Ann Jernigan, Tech. Div., (904) 434-1311 collect, SNELLING AND SNELLING, 428 Plaza Building, Pensacola FL 32505.

positions open

Chairperson—COASTAL & OCEANOGRAPHIC ENGINEERING. The College of Engineering, University of Florida invites nominations and applications for a tenure track position as Chairperson, Department of Coastal and Oceanographic Engineering. The position will be available July 1, 1981. Candidates must have an earned doctorate in coastal/or oceanographic engineering or related fields and several years of academic, governmental/or industrial experience. Candidates should have achieved distinction in research, have a strong interest in both educational programs and professional societies and have demonstrated leadership and administrative abilities. They should qualify for the rank of full professor. The deadline for applications is March 2, 1981. They should include a resume, list of publications, a description of research activities and interests, and the names, addresses and telephone numbers of at least three references. Submit application to: Dr. M. J. Ohanian, Search Committee Chairman, College of Engineering, 310 Weil Hall, UNIVERSITY OF FLORIDA, Gainesville, FL 32611. The University is an equal opportunity/affirmative action employer.

FACULTY POSITION: THE DEPARTMENT OF TECHNOLOGY AT SOUTHERN ILLINOIS UNIVERSITY at Carbondale seeks applicants for a tenure track position in engineering technology. The individual assuming the position will be required to teach a wide spectrum of baccalaureate level courses in mechanical engineering technology and develop appropriate research activities. Qualifications should include a minimum of a M.S. degree with a doctorate preferred. At least one degree should be in engineering, engineering technology, or a closely-related field. Teaching and industrial experience is preferred. Salary and rank will be commensurate with background and experience. U.S. citizenship or permanent residency required. Applications will be received until position is filled. Please contact: Search Committee, Department of Technology, SOUTHERN ILLINOIS UNIVERSITY at Carbondale, IL 62901. Phone: 618-536-3396. SOUTHERN ILLINOIS UNIVERSITY at Carbondale is an equal opportunity affirmative action employer.

MECHANICAL ENGINEERING DEPT, MIT, Jr and/or Sr level professorships 1981–82 and 1982–83. Teaching and research in ENGINEERING DESIGN (concept generalization, machine elements, analytical design and optimization), COMPUTER CONTROL AND SYSTEMS (analog and digital systems, computer-aided design and manufacturing, data acquisition, signal processing and direct digital control), MECHANICS AND CONTROL (classical dynamics, vibrations and waves, automatic control related to mechanical systems), DYNAMICS (vibrations and acoustics), MECHANICS AND MATERIALS (mechanical behavior of materials, materials processing and manufacturing), and FLUID AND THERMAL SYSTEMS (fluid mechanics, thermodynamics and heat transfer). Doctorate in Mech Eng or related field required. Industrial experience desirable. Salaries and benefits competitive. Send resumé, publications list and references to Head, Dept of Mech Eng, Massachusetts Institute of Technology, Cambridge, Ma 02139. An Equal Employment Opportunity/Affirmative Action Employer.

CHEMICAL AND MECHANICAL ENGINEERING DEPARTMENT, UNIVERSITY OF SOUTH FLORIDA. Primarily seeking applicants for assistant professor position in machine design. Academic and industrial experience sought in machine design, machine control, computer aided analysis, simulation and design. Successful applicant must be able to qualify for registration in Florida in two years. As other openings are anticipated, outstanding individuals with other talents in chemical and mechanical engineering are invited to apply. Visiting lectureships for doctoral candidates and outstanding masters candidates are also anticipated. Send applications and resumes to L. A. Scott, College of Engineering, University of South Florida, Tampa, FL 33620. An Equal Opportunity Employer.

FACULTY POSITION IN COMBUSTION. The Department of Mechanical and Nuclear Engineering at Northwestern University is seeking an outstanding individual for appointment as an assistant or associate professor. Candidate must have promise of excellence in teaching and demonstrated research capability in the general area of combustion with applications. Experimental knowledge and industrial experience are desirable. Inquiries should be made to Professor M. C. Yuen, Chairman, Department of Mechanical and Nuclear Engineering, NORTHWESTERN UNIVERSITY, Evanston, IL 60201 Affirmative Action/Equal Opportunity Employer.

ANALYTICAL ENGINEER: research and development engineer in product and structural design analysis. Emphasis on finite element and computer aided design analysis. Utilize IBM 370 series hardware, FORTRAN, numerical stress analysis, and related engineering theory to develop computer programs and systems for design, stress and stability analysis of machinery and components. Train other engineers in methodologies developed. 40 hrs./wk; $31,000/yr. Ph.D. in Theoretical and Applied Mechanics required, including computer design analysis. Apply to DEERE & COMPANY, Box 8000, Waterloo, Iowa 50704. Equal Opportunity Employer M/F.

RESEARCH ENGINEER: research in tribology, materials science, and computer simulation analysis. Study of heat transfer; torsional vibration; friction, wear and lubrication factors; and manufacturing materials used in auto. transmission systems. Use IBM 370 and FORTRAN to develop computer simulation programs for analysis of relative performance of same in model transmission systems. 40 hrs./wk; $31,000/yr. Ph.D. Mech. Engr., Tribology, including computer systems modeling. Apply to DEERE & COMPANY, Box 8000, Waterloo, Iowa 50704. Equal Opportunity Employer M/F.

positions open

DIRECTOR OF FACILITIES, UNIVERSITY OF SOUTHERN COLORADO, Pueblo, CO 81001. Responsibilities include directing the maintenance and operation of the University's physical facilities, coordinating capital construction development, as well as developing, recommending and controlling the annual operating budget. Qualifications required are a bachelor's degree in a plant-related field and three or more years of related engineering and/or contracting experience. Qualifications preferred are Mechanical or Civil Engineering degree, general business/personnel management experience, ability to work with State and Federal regulatory agencies and familiarity of central controls and automated systems for facility and energy management. Completed USC application, letter of intent and current resume, college transcripts and names, addresses and phone numbers of three references should be mailed no later than January 31, 1981 to: Judith Garcia Carder, Chairperson, Search and Screen Committee, c/o Physical Plant Department, UNIVERSITY of SOUTHERN COLORADO, 2200 N. Bonforte Blvd., Pueblo, Colorado 81001. USC is an Equal Opportunity Employer.

MECHANICAL ENGINEERING: WASHINGTON STATE UNIVERSITY is seeking applicants for a tenure-track position in the area of combustion. Tenure status and rank, at the assistant, associate, or full professor level, will be commensurate with the applicant's qualifications. A person is sought who has an ongoing research program, or a strong potential for establishing a research program, in some aspect of combustion such as optical diagnostics, coal combustion, pollutant formation, or numerical modelling. Duties include teaching at the graduate and undergraduate level in thermal and fluid sciences and supervision of graduate students at Master's and Ph.D. levels. The opportunity exists to interact with a vigorous faculty engaged in a variety of funded research programs in the thermal and fluid sciences. A Ph.D. in mechanical engineering or closely allied field is required. The position is currently open and applications will be received until filled. Send a complete resume and four references to: Richard W. Crain, Jr., Chairman, Department of Mechanical Engineering, Washington State University, Pullman, WA 99164. WSU is an equal opportunity/affirmative action employer women and minority applicants are actively sought.

THE MECHANICAL ENGINEERING DEPARTMENT AT BRADLEY UNIVERSITY is seeking a leader in the machine design area. Teaching duites may include courses from Freshman through MS level. Applicants should be competent designers, strong in relevant solid mechanics and machine design areas with the capability and desire to develop computer aided design and interdisciplinary activities. Doctorate and/or equivalent experience is desired. Salary and rank are commensurate with qualifications. Position available August 1981. Applications will be considered through February 1 or until position is filled. Send resume to Dr. Max Wessler, Chairman, Department of Mechanical Engineering, Bradley University, Peoria, IL 61625. An equal opportunity/affirmative action employer.

THE MECHANICAL ENGINEERING DEPARTMENT, UNIVERSITY OF KENTUCKY invites applications for tenure-track positions in two areas: 1) Thermal science with experience in fluids and two-phase flows, and 2) Design with experience in computer graphics and/or acoustics. The positions require an earned doctorate in Mechanical Engineering and the ability to develop a sound research program in the above areas. Duties include graduate and undergraduate teaching and supervision of graduate research. Rank and salary open. Deadline for receipt of applications is March 15, 1981. Send resume to Professor Richard Birkebak, Mechanical Engineering Department (00461), University of Kentucky, Lexington, KY 40506. The University of Kentucky is an equal opportunity employer.

TWO MECHANICAL ENGINEERING faculty positions, one in the design, dynamics and controls area and the other in thermal sciences and fluids at THE PENNSYLVANIA STATE UNIVERSITY. These positions are tenure track at the rank of Assistant or Associate Professor. A doctorate is required. Both positions require teaching undergraduate and graduate courses and the supervision of graduate research, solicitation of sponsored research, and other general faculty responsibilities. These positions are available immediately. Applications will be accepted until the positions are filled. Send full resume with names and addresses of three references to: Chairman, Department of Mechanical Engineering, Box A, Mechanical Engineering Building, University Park, PA 16802. The Pennsylvania State University is an Equal Opportunity/Affirmative Action Employer.

ASSISTANT PROFESSOR—WESTERN NEW ENGLAND COLLEGE/SPRINGFIELD, MASSACHUSETTS seeks Assistant Professor of Mechanical Engineering for tenure track position to develop and teach undergraduate and graduate courses and conduct research in the areas of machine design, applied mechanics, or computer simulation. Minimal requirements include Ph.D. candidate in final stages of dissertation, prior relevant teaching experience and effective communicating skills. Minimum full-time (9 mo. contract) starting salary is $20,500, however, salary will be commensurate with qualifications and experience. Interested applicants should send vitae, publication lists, abstracts of research and letters of reference to Dr. R. Luther Reisbig, Dean of Engineering, WESTERN NEW ENGLAND COLLEGE, Springfield, MA 01119. An equal opportunity/affirmative action employer.

Ph.D. IN ENGINEERING AND PUBLIC POLICY—The Department of Engineering and Public Policy at Carnegie-Mellon University offers an interdisciplinary research-oriented Ph.D. for persons with an undergraduate degree in engineering or the mathematical or physical sciences. Persons with more advanced training or experience are especially welcome. Some financial support is available. Contact: Engineering and Public Policy, CARNEGIE-MELLON UNIVERSITY, Pittsburgh, PA 15213.

positions open

POSITIONS OPEN—THE UNIVERSITY OF MANITOBA, DEPARTMENT OF CIVIL ENGINEERING. The Department of Civil Engineering is currently expanding its research and graduate studies program in the area of Applied Mechanics. Applications are invited for faculty & research positions from those with expertise in Applied Mechanics having research interest in the areas of solid mechanics, wave propagation, bio-mechanics, hydro-mechanics, river and ice-mechanics. Rank and terms of employment are negotiable. Please send complete resume, and the names of at least three references to: Professor H. Cohen, Division of Applied Mechanics, Department of Civil Engineering, University of Manitoba, Winnipeg, Manitoba, R3T-2N2, Canada. All applications should include a brief statement of research interest, and experience, as well as copies of recent publications. Canadian citizens, permanent residents, and others eligible for employment in Canada at the time of application are especially encouraged to apply.

THE DEPARTMENT OF MECHANICAL ENGINEERING AT THE UNIVERSITY OF TULSA has an opening for a faculty position beginning September 1, 1981. Applicants should have an earned doctorate in Mechanical Engineering or in a closely related discipline. Responsibilities include teaching undergraduate and graduate courses, and developing a funded research program. This is a tenure track position with starting rank and salary commensurate with background and experience. The Mechanical Engineering Department has ongoing research programs in stress analysis, fracture mechanics, acoustics, earthquake engineering, particulate control technology, dynamics of composite materials and enhanced oil and gas recovery methods. Send resume and references to Dr. Edmund Rybicki, Professor and Chairman, Department of Mechanical Engineering, University of Tulsa, 600 South College Avenue, Tulsa, Oklahoma 74104. The University of Tulsa has an Equal Opportunity/Affirmative Action Program for students and employees.

MECHANICAL ENGINEERING DESIGN FACULTY POSITIONS, The Ohio State University. Assistant/Associate professor for mechanical design area with specialty in mechanical reliability, component design, stress and failure analysis, machinery dynamics, experimental methods and/or computer-aided design, with strong interest in applications. Ph.D. in Mechanical Engineering required. Preference will be given to teaching and industrial experience but all applicants will be considered. Position requires undergraduate and graduate teaching activity with research responsibilities. Experience with sponsored research programs desirable. Application should be made as soon as possible but no later than January 26, 1981. Send detailed resume and names of references to Professor J. A. Collins, Department of Mechanical Engineering, THE OHIO STATE UNIVERSITY, 206 West 18th Avenue, Columbus, Ohio 43210. An affirmative action/equal opportunity employer.

MECHANICAL ENGINEERING; Temporary Instructor. One-half to full-time appointment available fall semester, 1981. Duties will be undergraduate teaching in the general area of Mechanical Engineering. An M.S. degree in Mechanical Engineering is required. Applicants must be qualified for entrance into the graduate school and must enroll for work toward the Ph.D. Teaching and/or industrial experience is desirable. Salary commensurate with qualifications and experience. This is an academic year (9 month) appointment, but should continue for several years. Applicants should send detailed resume, with references, to Dr. Paul L. Miller, Professor and Head, Department of Mechanical Engineering, KANSAS STATE UNIVERSITY, Manhattan, Kansas 66506. Telephone inquiries invited (913 532-5610). Applications will be accepted through February, 16, 1981. Kansas State University is an Equal Opportunity/Affirmative Action Employer.

AEROSPACE AND MECHANICAL ENGINEERING. Three tenure-track faculty positions available Fall semester 1981. Areas of interest include, but are not limited to, CAD/CAM, combustion, computational fluid mechanics, aircraft structures. Duties include teaching undergraduate and graduate courses and developing independent research programs. Rank and salary commensurate with qualifications, but the assistant professor level is preferred. Send vita and names of three references to Dr. C. F. Chen, Department of Aerospace and Mechanical Engineering, UNIVERSITY OF ARIZONA, Tucson, AZ 85721. Closing date February 28, 1981. University of Arizona is an Affirmative Action/Equal Opportunity Employer.

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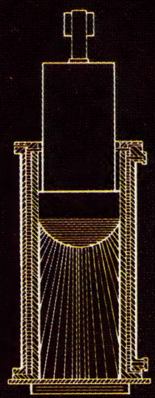

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